Appendix A:

Consolidated Emissions Inventory Report

ENVIRON

International Corporation — *Air Sciences*

Final Report

CLARK COUNTY CONSOLIDATED EMISSION INVENTORY REPORT

Prepared for

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1. INTRODUCTION

This report provides a compendium of all of the emission inventory development work prepared for the Clark County Department of Air Quality and Environmental Management (DAQEM) for use in 8-hour ozone State Implementation Plan (SIP) modeling performed by DAQEM. The emissions by sector were prepared by environmental consulting companies and Nevada university groups. This report provides a brief overview of the methods used to estimate the various emissions sources, and a summary of the overall emissions for base and future years.

EMISSION INVENTORY SCOPE

The scope of the overall emission inventory effort was as follows:

Pollutants: The ozone precursor pollutants included in the emission inventories are volatile organic compounds (VOCs), nitrogen oxides (NO_x), and carbon monoxide (CO).

Source Categories: The emission inventories consist of six major source categories:

- *Point sources* are stationary sources, defined as any facility emitting greater than 10 tons of VOC or 25 tons of NO_x annually, plus some hotels/casinos selected by DAQEM to be included in the point source inventory. As defined for this project, there are 63 point source facilities currently operating in Clark County in 2002; their emissions are primarily from fuel combustion.

- *Area sources* are defined as all stationary sources that are not included in the point source inventory. These numerous facilities and activities include gasoline dispensing facilities, architectural surface coatings, industrial surface coatings, degreasing, and consumer solvents.

- *On-road mobile sources* include emissions from vehicles certified for highway use – cars, trucks, and motorcycles. On-road emissions are of two types: exhaust (or tailpipe) emissions of VOC, NOx, and CO; and VOC evaporative emissions.

- *Off-road mobile sources* encompass a wide variety of equipment types that either move under their own power or are capable of being moved from site to site, and are not certified for highway use. For this project, off-road mobile sources include agricultural, construction and mining, industrial and commercial, lawn and garden, recreational, and pleasure craft engines and equipment. Locomotive emissions are also included in this category.

- *Airports* emissions sources include aircraft, aircraft ground support equipment, auxiliary power units, ground access vehicles, and airport stationary sources.

- *Biogenic emissions* arise from natural sources – trees, plants, scrub, and grasses.

Geographical Domain: The emission inventories described in this report are for the whole of Clark County. DAQEM's modeling domain encompasses a much larger area, and development of the emission inventories for the areas within the modeling domain but outside Clark County are described in other DAQEM reports.

Temporal Resolution: The base years for the emission inventory work and air quality modeling are 2002 and 2003. The emission inventory projection years for air quality modeling are 2008, 2013, and 2018. For point, area, nonroad, and airport sources, emissions were estimated as an annual total and for a summer average day. Biogenic emissions were estimated for an average summer day only. On-road emissions were estimated at a more detailed level, for every hour of the day for each day in summer modeling episode.

EMISSION INVENTORY REPORTS

The emission inventories were developed by a number of consulting and research groups under contract to the DAQEM. Table 1-1 lists the organizations that developed the emission inventory components, and the title of the final reports. The emission inventory methods descriptions provided in Section 2 of this report are extracted from these contributing reports without further attribution. Each of the reports listed in the table includes a much lengthier discussion of the emission inventory methods and activity data used, assumptions made, and examples of calculations. These reports also include more detailed discussion of the results than is included in Section 3 of this report.

Table 1-1. Emission inventory reports completed for DAQEM.

Source Category	Report title and contractor
Point	"Clark County Point and Area Source Emissions" (ENVIRON/ERG, 2007)
Area	"Clark County Point and Area Source Emissions" (ENVIRON/ERG, 2007)
On-road	"Clark County On-road Mobile Source Emissions" (ENVIRON, 2007)
Nonroad	Emissions prepared by DAQEM; documented in this report.
Airports	"Emissions Inventories for Clark County Airport System Airports" (Ricondo, 2006) and "Vertically Distributed Aircraft Emissions Inventories for McCarran International Airport and the Proposed Ivanpah Airport" (CDM, 2006).
Biogenic	"Biogenic Volatile Organic Compound Emission Inventory Improvement Project" (DRI, 2006)

2. METHODS FOR ESTIMATING EMISSIONS, BASE AND FUTURE YEARS

This section briefly describes the methods and data that were used to estimate the emissions in each of the major source categories. Further details on emissions estimation methods, data used, assumptions, and modeling techniques may be found in each of the emissions project reports listed in Section 1.

ON-ROAD MOBILE EMISSIONS

On-road emissions are estimated as the product of vehicle miles traveled (VMT) or vehicle trips activity data and gram/mile or gram/trip emission factors. The emission factors are derived from EPA's regulatory motor vehicle emission factor model, MOBILE6. MOBILE6 estimates emissions by vehicle class, and provides emission factors for exhaust emissions, evaporative emissions, and brake and tire wear emissions. The eight vehicle classes that were modeled are listed in Table 2-1.

Table 2-1. MOBILE5 vehicle classes for which emissions were estimated.

Vehicle Class	MOBILE Code	Weight Description
Light-duty gasoline vehicles (passenger cars)	LDGV	Up to 6000 lb gross vehicle weight (GVW)
Light-duty gasoline trucks (pick-ups, minivans, passenger vans, and sport-utility vehicles)	LDGT1	Up to 6000 lb GVW
	LDGT2	6001-8500 lb GVW
Heavy-duty gasoline vehicles	HDGV	8501 lb and higher GVW equipped with heavy-duty gasoline engines
Light-duty diesel vehicles (passenger cars)	LDDV	Up to 6000 lb GVW
Light-duty diesel trucks	LDDT	Up to 8500 lb GVW
Heavy-duty diesel vehicles	HDDV	8501 lb and higher GVW
Motorcycles	MC	

The MOBILE6 model includes the effects of all promulgated Federal regulations for on-road motor vehicles:

- Tier 1 light-duty vehicle standards, beginning with, beginning MY 1996;
- National Low Emission Vehicle (NLEV) standards, beginning MY 2001;
- Tier 2 light-duty vehicle standards beginning MY 2005, with low sulfur gasoline beginning summer 2004;
- Heavy-duty vehicle standards beginning MY 2004; and
- Heavy-duty vehicle standards beginning MY 2007, with low sulfur diesel beginning summer 2006.

The model was used to generate emission factors for all base and future years, with growth in VMT from the base to future years provided by local agencies. On-road emissions in the Las Vegas Valley were estimated using detailed data on the Las Vegas transportation network to estimate emissions for each link (roadway segment) in the network for each hour of the day.

Emissions in Clark County outside the Las Vegas Valley were estimated using county-level VMT data. These two development approaches are briefly described below.

On-Road Emissions in the Las Vegas Valley

VMT activity data for the base and future years in the Las Vegas Valley were provided by the Southern Nevada Regional Transportation Commission (RTC). The data were provided from the RTC's TransCAD transportation demand model (TDM), which estimates VMT by link for each of seven time periods of the day. The RTC transportation network included about 16,500 links in 2002, growing to about 22,000 links in 2018. The CONCEPT motor vehicle (MV) model[1] was used to combine the vehicle activity data with MOBILE6 emission factors to generate gridded hourly model-ready emissions estimates for each day in the summer ozone modeling time period of interest.

The RTC TDM data are for seven periods of the day (midnight - 7am, 7am- 9am, 9am – 2pm, 2pm – 4pm, 4pm – 6pm, 6pm – 8pm, and 8pm – midnight) for an average weekday; weekend days are not modeled. Three types of VMT adjustments were applied to the RTC link VMT: (a) an adjustment to match the link volumes to observed traffic counts by facility type, (b) an adjustment to bring the total volume into agreement with the VMT reported through the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS), and (c) a transit adjustment to account for public transit activity not included in the RTC network modeling.

CONCEPT MV uses VMT temporal profiles to disaggregate the VMT from the seven time period to 24 hours of the day for both weekdays and weekends. These VMT temporal profiles were generated from analysis of Nevada Department of Transportation (NDOT) continuous traffic monitoring data from 90 locations in Clark County. The hourly total VMT for each link was then disaggregated into the eight vehicle classes listed in Table 2-1 using VMT mix temporal profiles, which were developed from analysis of two Clark County databases: NDOT data from 46 vehicle classification monitoring sites, and a Las Vegas traffic monitoring study with 68 vehicle classification monitors (Orth-Rogers Associates, 2003).

The VMT data by vehicle class were allocated to the grid cells in the modeling domain based on the start and end coordinates for each link. MOBILE6 was then run for each link in each grid cell, using meteorological data (temperature and humidity) for each grid cell from meteorological modeling performed by DAQEM, and other MOBILE6 inputs provided by DAQEM. For each hour for each link in each grid cell, CONCEPT MV then multiplied the MOBILE6 emission factor and VMT, by vehicle class.

The RTC also provided data on vehicle trip starts and ends for each of about 1200 traffic analysis zones (TAZs). These trip starts and ends were used for spatial allocation (by TAZ) of exhaust start and evaporative hot soak emissions.

Although not in the Las Vegas Valley, the southern part of I15 in Clark County, from Las Vegas to the California border, was modeled using CONCEPT MV along with the Las Vegas Valley transportation network. Interstate 15 is a route that is heavily used for traveling between Las

[1] The CONCEPT model and documentation are available at http://www.conceptmodel.org/.

Vegas and the Los Angeles area, with traffic particularly heavy on I15 on Sunday evenings heading south to California, and special treatment was given to this roadway to take into account these varying traffic patterns. The RTC provided VMT data for the southern part of I15 for the base and future years, and hourly traffic volumes per direction were determined for each day of the week bi-directional count data from an NDOT continuous observation monitoring site on I15 at the CA/NV border.

On-Road Emissions Outside the Las Vegas Valley

On-road emissions in the rural areas of Clark County, outside the Las Vegas Valley, were estimated by roadway type using rural HPMS VMT data by roadway type. These were multiplied by the appropriate MOBILE6 emission factors. The resulting daily average emissions were allocated to the hours in the modeling period using the temporal profiles derived from analysis of NDOT rural traffic monitoring data, and then gridded using EPA roadway spatial allocation surrogates.

NONROAD MOBILE EMISSIONS

NONROAD Model Equipment

Nonroad mobile equipment encompasses a wide variety of equipment types that either move under their own power or are capable of being moved from site to site. Emissions for so-called traditional nonroad sources are estimated by EPA in their NONROAD emissions model, the latest version of which is NONROAD2005.

The NONROAD model includes both emission factors and default county-level population and activity data. The model therefore estimates not just emission factors but also emissions. The NONROAD model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating and fuel type, in the following categories:

- airport ground support, such as terminal tractors;
- agricultural equipment, such as tractors, combines, and balers;
- construction equipment, such as graders and back hoes;
- industrial and commercial equipment, such as fork lifts and sweepers;
- recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- residential and commercial lawn and garden equipment, such as leaf and snowblowers;
- logging equipment, such as shredders and large chain saws;
- recreational marine vessels, such as power boats;
- underground mining equipment; and
- oil field equipment.

The NONROAD model does not include commercial marine, locomotive, and aircraft emissions.

The NONROAD model incorporates the effects of promulgated Federal nonroad equipment regulations, up through the latest Tier 4 emissions standards for nonroad compression-ignition engines and low sulfur nonroad diesel fuel. The basic equation for estimating emissions in the NONROAD model is as follows:

$$Emissions = (Pop)(Power)(LF)(A)(EF)$$

where

Pop = Engine Population
Power = Average Power (hp)
LF = Load Factor (fraction of available power)
A = Activity (hrs/yr)
EF = Emission Factor (g/hp-hr)

The NONROAD model has default estimates for all variables and factors used in the calculations. All of these estimates are in model input files, and can be changed by the user if data more appropriate to the local area are available. No local data were available for Clark County, and so model defaults were used.

The NONROAD2005 model was used to estimate nonroad emissions for all base and future years. The model internally incorporates fleet turnover effects, as older engines are replaced by newer engines under stricter control regulations, and thus the emission factors by engine type decrease over time. Increases in emissions populations are also estimated within the model.

The GSE emissions estimates from the NONROAD model were dropped, as they were estimated as part of the airport emission inventories, described below.

Locomotive Emissions

The only source of locomotive emissions in Clark County is the Union Pacific Railroad (UPRR), which operates freight trains on about 141 miles of track. UPRR also has two switching stations in the Las Vegas area. Locomotive emissions were estimating using data provided by UPRR on ton-mileage and fuel consumption on eight track segments in the county, and EPA locomotive emission factors for line haul and switching operations for locomotives manufactured between 1973 and 2001.

Future year locomotive emission estimates were based on the uncontrolled 2002 emissions, emission activity growth factors, and emission control factors. The growth factors were estimated from a combination of Clark County transportation expenditures data and national data representing the change in railroad energy intensity (UNLV, 2003; DOE, 2003). The locomotive emission factor reductions were derived from the EPA locomotive emissions regulatory support document (EPA, 1998b).

AIRPORT EMISSIONS

Emissions were estimated for all airport sources at the following airports currently in operation in the Las Vegas area:

- McCarran International Airport
- North Las Vegas Airport
- Henderson Executive Airport
- Jean Airport
- Perkins Field Airport

Emissions were also estimated for the South of Sloan Regional Heliport Site, which will not be operational until 2009, and for the planned Ivanpah airport near Jean. The Ivanpah airport plan is currently undergoing environmental review, and the airport will not be operational until 2017. In the airports emission inventories, Ivanpah aircraft and aircraft-related emissions are included only in the 2018 emissions, and emissions related to construction for the airport are included in the 2008 and 2013 airports inventory.

2002 and 2003 Base Year Methods

The airport emissions inventories were developed using the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS, version 4.3), the EPA's preferred guideline model for air quality analyses at airports. The EDMS was used to estimate airport-related emissions from five source categories:

- Aircraft emissions, which are a function of the number of annual aircraft operations, expressed as landing and takeoff (LTO) cycles, the aircraft fleet mix (types of aircraft used), and the length of time aircraft spend in each of the four modes of operation defined in EDMS: takeoff, climbout, approach, and idle.

- Auxiliary power units (APUs), which are typically small turbine engines that generate electricity and compressed air to operate aircraft instruments, lights, and ventilation systems when the main aircraft engines are not operational, such as when aircraft are parked at the gate. APUs can also be used to provide power for starting the main aircraft engines. Emissions from APUs are tied to the number of LTO cycles performed by aircraft equipped with APUs, and the operating times of the APU per LTO cycle.

- Ground support equipment (GSE), which includes a wide range of vehicles used to service aircraft. Examples of GSE include tugs that haul baggage carts and other equipment, fuel trucks, catering trucks and other service vehicles, and ground power units that provide electrical power to aircraft when they are parked and the engines are not running. The EDMS database includes default GSE assignments for each aircraft type expressed in terms of total operating times by specific type of GSE per LTO cycle.

- Point sources, such as power generating and heating plants, incinerators, fuel storage tanks, and surface coating facilities. The airport emissions inventory includes point sources owned and controlled by the Department of Aviation.

- Ground access vehicles on airport roadways and in airport parking lots and garages (off-airport motor vehicle emissions are accounted for in the on-road emissions inventory). The number of passenger vehicle trips and airport shuttle vehicles are based on the number of aircraft LTOs, and emission factors were generated using the MOBILE6.2 model with the same inputs as used for the on-road emission inventory.

The EDMS estimates emissions from all these sources, with activity data provided. Activity data for aircraft operations and point sources were provided by the Department of Aviation. Activity for APUs, GSE, and ground access vehicles were estimated as a function of the aircraft LTO activity.

Projection Methods

The 2008, 2013, and 2018 inventories for the Las Vegas area airports include emissions associated with the five source categories listed above for the base years. In addition, construction emissions were estimated for major construction projects: the 2013 airports emission inventory includes construction emissions for the new Ivanpah airport, and the 2008 inventory includes construction emissions associated with the South of Sloan Regional Heliport.

The FAA EDMS model was used to estimate airport emissions in the future years in the same manner as for the base years. The Clark County Department of Aviation provided aircraft operations data (LTOs) for all airports; these LTO emissions are the basis for the EDMS emissions estimates for aircraft, APUs, GSE, and vehicle trips. Aircraft taxi times were increased in 2008 and 2013 for McCarran, as the number of aircraft movements nears the airport capacity.

For point sources, future year activity projections (primarily fuel consumption) were obtained from permits and environmental assessment reports; included here are the point sources associated with the future Terminal 3 at McCarran in 2013 and 2018. Airport access vehicle trips are tied to LTOs, and the future year emission factors were generated using EPA's MOBILE6 model with the estimated Las Vegas area fleet for each year.

POINT SOURCE EMISSIONS

2002 and 2003 Base Year Methods

There are 63 point source facilities operating in Clark County in 2002. These include major sources (i.e., those emitting 10 tons of VOC or 25 tons of NO_x annually) plus certain other emitters of ozone precursor selected by DAQEM to be included in the point source inventory (hotels/casinos).

The DAQEM compiled the annual point source emissions inventory for these facilities for 2002 and 2003, using data submitted by each facility in an annual "Emissions Inventory Report." After receiving the annual Emissions Inventory Report from a facility, the DAQEM emissions analyst quality assured the emissions estimate as follows:

- Mass balance was used to verify activity data (e.g., SO_2 emissions from natural gas combustion).
- Emission factors were verified (e.g., checked against AP-42); continuous emissions monitor (CEM) data had preference over source test data, and source test data (or emission factors developed from them) had preference over AP-42 emission factors.
- Georeference data (stack locations) and stack parameters (stack exit temperature, height, diameter, and flow rate) were verified, and many cases were gap filled using information obtained from other departments within DAQEM, such as permitting.

In cases where activity data, emission factors, or calculations could not be verified, then the DAQEM emissions analyst made a new calculation(s) and estimate(s) of emissions. For example, a common error found in the 2002 Emissions Inventory Reports was missing emission factors. To supplement this information and verify the reported emissions, the DAQEM emissions analysis would back-calculate an emission factor/rate and check this against either AP-42 or the emission rate(s) allowed or otherwise stipulated in the facility's operating permit. If the back-calculated emission factor/rate could not be verified, then the correct emission factor/rate was used to re-calculate a new emissions estimate for the facility. In these cases, the detailed calculations performed by the DAQEM emissions analyst were recorded and placed in the individual facility emission inventory files, which are kept at the DAQEM offices.

After duplicating or revising the emissions inventory data, the DAQEM engineer entered the resulting emissions into the *Emissions Inventory Information Management System (EIIMS) View Version 0.3.925* software package. Although *EIIMS View* has the capability of internally calculating the emissions (i.e., based on user-provided activity data and user-selected emission factors, etc.), the DAQEM emissions analyst performed all emission verification calculations external to the software and then entered the results into *EIIMS View* for data management and reporting.

Projection Methods

DAQEM compiled the point source emissions for 2002 and 2003, and the future year emissions were then estimated by multiplying the 2003 base year emissions by the appropriate SCC-specific growth factor for each future year. SCC-specific growth factors were developed using the EGAS (Version 5.0) growth factor model for the state of Nevada for the future years of 2008, 2013, and 2018 (Abt, 2004; U.S. EPA, 2004b). Also, retirement fractions (i.e., estimated percentage of the equipment population retiring each year) were adjusted to account for the 5-, 10-, or 15-year projection period beginning from the 2003 base year.

One key exception to the use of EGAS growth factors was for power plants (electricity generating units, or EGUs), for which a methodology developed for the Western Regional Air Partnership (WRAP) was used. Instead of projecting these emissions using the EGAS growth factors, the capacity threshold emissions for the existing EGUs were obtained from the WRAP projected emissions for Nevada (ERG, 2006a). For Clark County, it was assumed that all existing EGUs will reach their individual capacity thresholds by 2008, i.e., that there would be growth from 2003 to 2008 and none thereafter in the existing EGUs.

For the future year projected emissions, a number of EGUs and cement kilns were added to the inventories. These facilities are either under construction, currently being permitted, or planned for future construction. These facilities, and the first inventory year in which they are included, are listed in Table 2-2. The future year emissions for these facilities were either provided by DAQEM or were extracted from future year emissions projections previously developed by ERG for the Western Regional Air Partnership (ERG, 2006a).

Table 2-2. Planned Clark County point sources on-line after 2003.

Facility	Status	First Inventory Year
Nevada Power – Chuck Lenzie gas-fired EGU	Under construction	2008
Genwest – Silverhawk gas-fired EGU	Under construction	2008
Ivanpah Energy gas-fired EGU	Being permitted	2013
Sempra Energy – Copper Mountain gas-fired EGU	Being permitted	2013
Calpine gas-fired EGU	Planned	2013
Ashgrove – Moapa cement kiln	Planned	2013
LaFarge cement kiln	Planned	2013

AREA SOURCE EMISSIONS

Area sources are defined as all stationary sources (both anthropogenic and non-anthropogenic) that are not included in the point source inventory. Area source emissions for the 2002 base year were estimated by ENVIRON, and ERG developed the future year projected emissions. Emissions for agricultural burning, wildfires, and prescribed fires were not included in the ENVIRON/ERG calculations, as DAQEM used the day-specific typical year fire emissions developed for the WRAP (Air Sciences, 2005).

2002 and 2003 Base Year Methods

Area source emissions for the 2002 base year were generally estimated as the product of an emission factor and activity data. The methods and emission factors were typically from EPA's Emission Inventory Improvement Program (EIIP) guidance documents, available at http://www.epa.gov/ttn/chief/eiip/techreport/, or EPA's AP-42 emission factors, available at http://www.epa.gov/ttn/chief/ap42/index.html. For all source categories, local activity data were used if available. Table 2-3 lists the area source emission source categories estimated, the method/emission factor source, and the activity data used. The area source emission inventory report contains details of the methods, emission factors, and activity data used, as well as example calculations for all source categories.

Table 2-3. Emissions estimation methods and activity data use to estimate area sources.

Source Category	Method/Emission Factors Source	Activity Data	Activity Data Source
Architectural Surface Coating	EIIP, Volume III, Chapter 3	County population; National paint statistics.	Clark County Comprehensive Planning population estimates; US Census 2002 report on paint and allied products.
Autobody Refinishing	EIIP, Volume III, Chapter 13	County SIC-specific employment	County Business Patterns.
Bakeries	EIIP, Area Source Category Method Abstract	County population	Clark County Comprehensive Planning population estimates.
Commercial Fuel Combustion	EIIP, Area Source Category Method Abstract; AP-42, Section 1	Annual fuel usage; 2002 heating degree days; County SIC-specific employment	Energy Information Administration; Western Regional Climate Center; County Business Patterns.
Consumer Products	California Air Resources Board (CARB) per person emission factors	County population, with adjustment for tourists	Clark County Comprehensive Planning population estimates;

Source Category	Method/Emission Factors Source	Activity Data	Activity Data Source
			Las Vegas visitors survey
Cutback Asphalt Paving	EIIP, Volume III, Chapter 17	Asphalt usage and characteristics	Nevada Department of Transportation.
Dry Cleaning	EIIP, Volume III, Chapter 4	County Business Patterns.	Clark County Comprehensive Planning population estimates.
Gasoline Storage, Transport, and Distribution	EIIP, Volume III, Chapter 11; EPA MOBILE6 model	County gasoline sales; Vehicle Miles Traveled.	Clark County DAQEM; Clark County Mobile Source Emissions Inventory.
Graphic Arts	EIIP, Volume III, Chapter 7	County population	Clark County Comprehensive Planning population estimates.
Industrial Fuel Combustion	EIIP, Area Source Category Method Abstract; AP-42, Section 1	Annual fuel usage; County SIC-specific employment	Energy Information Administration; County Business Patterns.
Industrial Surface Coating	EIIP, Volume III, Chapter 8	County SIC-specific employment; County population	County Business Patterns; Clark County Comprehensive Planning population estimates.
Municipal Waste Landfills	EIIP, Volume III, Chapter 15	Per capita waste generation rate; County population.	Nevada Division of Environmental Protection; Clark County Comprehensive Planning population estimates.
Open Burning (residential yard and household waste)	EIIP, Volume III, Chapter 16	Open burning permits issued; Per capita waste generation rates.	Clark County DAQEM; EPA nationwide and Nevada Division of Environmental Protection Clark County waste generation rates.
Pesticide Application	EIIP, Volume III, Chapter 9	Crop acreage; Pesticide application rates; Pesticide formulation	National Agricultural Statistics Service; National Center for Food and Agricultural Products US pesticide usage survey; Crop Data Management System.
Residential Fuel (non-wood) Combustion	EIIP, Area Source Category Method Abstract; AP-42, Section 1	Annual fuel usage; Home heating fuel distribution; 2002 heating degree days.	Energy Information Administration; 2000 Census; Western Regional Climate Center.
Residential Wood Combustion	2000 National Residential Wood Combustion Inventory (Goehl et al., 2001)	Per capita wood consumption; Wood burning equipment types; HDD.	Washoe County Residential Wood Combustion Survey; Clark County DAQEM Air Quality Regulations; Western Regional Climate Center.
Solvent Cleaning/Degreasing	EIIP, Volume III, Chapter 6;	County SIC-specific employment.	County Business Patterns.
Structural Fires	EIIP, Volume III, Chapter 18	Number of structural fires in 2005	Clark County Fire Department, City of Las Vegas Fire Department, City of Boulder Fire Department, City of Henderson Fire Department, and City of North Las Vegas Fire Department
Traffic Markings	EIIP, Volume III, Chapter 14	Traffic Marking Paint Applied; Population.	Nevada Department of Transportation, City of Las Vegas Public Works Department, and Clark County Public Works Department; Clark County Comprehensive Planning population estimates.
Vehicle Fires	EIIP, Area Source Category Method Abstract	Number of vehicle fires in 2005.	Clark County Fire Department, City of Las Vegas Fire Department, City of Boulder Fire Department, City of Henderson Fire Department, and City of North Las Vegas Fire Department.
Wastewater Treatment	NEI 2002 Methodology	Treated wastewater quantities and characteristics.	Clark County Water Reclamation District, Clark County Sanitation District.

Projection Methods

For area sources the base year was 2002, and the future projection years were 2003, 2008, 2013, and 2018. The growth factors for most area source categories were developed using the EGAS (Version 5.0) growth factor model for the state of Nevada (Abt, 2004; U.S. EPA, 2004b). The same growth factors were used for the annual, winter average day, and summer average day emission projections for a given future year. Projected emissions were estimated by multiplying SCC-specific base year emissions by the appropriate SCC-specific growth factor for each future year. The only area source category that was not estimated in this manner was future year Stage II vehicle refueling emissions; these were estimated using the Clark County VMT estimated for each projection year as described above and emission factors specific to each future year from MOBILE6.

Although U.S. EPA has begun to question the underlying assumption that emissions growth (as estimated for purposes of regulatory impact analyses) is proportionately dependent upon economic growth (U.S. EPA, 2006), the current projections guidance continues to recommend EGAS. However, use of local data, if available, is always recommended (Solomon, 2006). Upon examination of the 2002 emissions and preliminary growth factors developed by ERG using the state-level EGAS 5.0 model, it was decided to use recently available local data to estimate growth factors for four significant area source categories: architectural surface coatings, industrial surface coatings, degreasing, and consumer solvents. These local data were obtained from the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas (UNLV) (CBER, 2006; Schwer, 2006). Like the state-level EGAS growth factors, the CBER data were also based on economic data from the Policy Insight model from Regional Economic Models, Inc. (REMI). However, CBER’s REMI data were NAICS-based (i.e., more up-to-date than the SIC classification), and for Clark County only (i.e., more locally specific than the state-level EGAS/REMI data). A more detailed discussion of the revised growth factors from CBER REMI can be found in a separate technical memorandum (ERG, 2006d).

BIOGENIC EMISSIONS

The 2003 biogenic emission inventory was developed by the Desert Research Institute (DRI) and Dr. Alex Guenther of the National Center for Atmospheric Research (NCAR). This latest inventory effort is an improvement over previous emission inventory efforts as it incorporates an improved next-generation biogenic emissions model (MEGAN), satellite data to more accurately estimate leaf biomass density, and updated biogenic emission factors.

During the summer of 2006, DRI scientists carried out an extensive survey of biogenic VOC emissions from plants within Clark County using a unique field-portable biogenic VOC sampling system that was specifically designed to measure arid species. Field measurements of plant biogenic emissions were carried out over four months (May—August), which allowed for repeated sampling of certain species. The species measured accounted for over 85% of the vegetative cover within the county.

Seven field sites were selected to meet multiple goals: the presence of multiple plant species, availability of a local knowledgeable expert on plant identification, and representativeness of typical growing conditions for the species of interest. The seven sampling sites and their locations are listed in Table 2-4.

Table 2-4. Location of the research sites used for estimating biogenic emission factors.

Sampling Site	Location
Angel Park Golf Course	241 South Rampart Blvd., Las Vegas, NV 89145
Sunset Park	SE corner, intersection of Sunset Rd. & Eastern Ave., Las Vegas, NV 89120
Deerbrooke neighborhood	Intersection of Craig Rd. & Buffalo Dr., Las Vegas, NV 89129
Desert Research Institute	755 E. Flamingo Rd., Las Vegas, NV 89119
Clark County Complex	500 S. Grand Central Pkwy, Las Vegas, NV 89155
Nevada Desert Face Facility	Mercury, NV, 60mi. NW of Las Vegas, NV
Mt. Charleston Wilderness	Spring Mtns., 35 mi. WNW Las Vegas, NV (2 locations on an elevation gradient)

The biogenic emissions were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN) framework, developed at NCAR. MEGAN has improved land cover characterization compared to prior biogenic emissions modeling efforts: the MEGAN inventories are based on land cover data from the Southwest Regional Gap Analysis Project (SWReGAP) data, and satellite derived estimates of leaf area index.

Biogenic emissions were estimated for the summer of 2003, and these same emissions estimates were used for all future year modeling.

3. EMISSION INVENTORIES

In this section the emission inventory results are presented by major source category in tables and graphs. More details on the emission inventory results for the base and future years for each major source category may be found in the individual emission inventory reports listed in Table 1-1.

Table 3-1 shows the summer average day and annual emissions by major source category for each of the base and future years. Note that biogenic emissions are included only in the summer average day emissions; biogenic emissions were not estimated for the winter season and are therefore not included in the annual emissions tables. These emissions are graphically portrayed in Figures 3-1 (VOC), 3-2 (NOx), and 3-3 (CO). The tables and figures show that, despite large expected population growth, overall VOC emissions area decreasing slightly, NOx emissions are decreasing, and CO emissions are increasing slightly.

Emissions trends by major source category vary:

- Point source emissions are a significant contributor to overall NOx emissions, and a very small fraction of overall VOC and CO emissions. Point source NOx emissions are estimated to decrease slightly from 2002 to 2008, and then increase to about 2002 levels in 2018.
- Area source emissions are a significant contributor to VOC emissions, especially in the summer with higher temperatures. Area source VOC emissions are projected to increase from 2002 to 2018, as they are primarily associated with population increases and most of the area sources are uncontrolled.
- On-road mobile sources are a significant contributor to all ozone precursor inventories, but their contribution is decreasing over time (on both an absolute and relative basis) despite large increases in activity as older vehicles are retired and replaced by newer vehicles meeting much tighter federal emissions standards.
- Nonroad mobile sources are also a significant contributor to all ozone precursor inventories, and their contribution is also decreasing over time on both an absolute and relative basis. Activity will be increasing, but most nonroad sources are now covered under federal nonroad engine and equipment standards that phase in over time.
- Airport emissions are a very small fraction of overall VOC and NOx emissions, and a small fraction of overall CO emissions. Airport emissions are projected to increase over time with significant increases in travel to and from the Las Vegas area.
- Biogenic emissions are estimated to be the largest source of VOC emissions in Clark County for the average summer day. Biogenic emissions were estimated only for the base year. It was assumed that these emissions would remain constant in the future year modeling.

Table 3-1. Summer and average annual day emissions, 2002-2018.

2002	Summer Average Day (TPD)			Annual (TPY)		
	VOC	CO	NOx	VOC	CO	NOx
Point Sources	5.2	15.5	114.4	1,840	5,303	37,549
Area Source Emissions	40.5	1.4	2.6	16,267	4,708	1,904
Biogenics[a]	132.0	25.9	5.0	-	-	-
Mobile Sources[b]	67.9	723.5	44.7	15,584	167,162	14,570
On-Road Mobile Sources	70.1	552.1	103.1	20,496	192,114	37,354
Airports	2.1	43.0	9.3	785	15,696	3,413
Totals	**317.9**	**1,361.4**	**279.2**	**54,971**	**384,983**	**94,790**

2003	Summer Average Day (TPD)			Annual (TPY)		
	VOC	CO	NOx	VOC	CO	NOx
Point Sources	4.7	15.2	101.9	1,674	5,147	33,555
Area Source Emissions	42.1	1.4	2.6	16,789	4,541	1,870
Biogenics[a]	132.0	25.9	5.0	-	-	-
Mobile Sources[b]	67.0	741.7	44.1	15,301	171,187	14,355
On-Road Mobile Sources	69.4	532.6	100.4	20,289	185,323	36,355
Airports	2.0	44.6	8.3	722	16,290	3,013
Totals	**317.3**	**1,361.4**	**262.2**	**54,774**	**382,489**	**89,148**

2008	Summer Average Day (TPD)			Annual (TPY)		
	VOC	CO	NOx	VOC	CO	NOx
Point Sources	5.8	20.3	95.7	2,028	6,884	31,378
Area Source Emissions	51.4	1.6	2.7	20,378	5,043	2,129
Biogenics[a]	132.0	25.9	5.0	-	-	-
Mobile Sources[b]	55.5	805.9	38.7	12,003	185,166	12,547
On-Road Mobile Sources	64.2	427.3	76.1	19,103	178,342	28,965
Airports	2.4	52.2	14.5	879	19,063	5,306
Totals	**311.3**	**1,333.3**	**232.8**	**54,391**	**394,498**	**80,325**

2013	Summer Average Day (TPD)			Annual (TPY)		
	VOC	CO	NOx	VOC	CO	NOx
Point Sources	7.5	29.5	115.0	2,678	10,227	38,477
Area Source Emissions	60.3	1.8	2.9	23,665	5,207	2,355
Biogenics[a]	132.0	25.9	5.0	-	-	-
Mobile Sources[b]	51.8	865.0	31.9	11,033	198,155	10,310
On-Road Mobile Sources	50.3	372.8	47.3	15,193	166,238	17,982
Airports	2.4	56.9	15.7	884	20,776	5,732
Totals	**304.4**	**1,352.0**	**217.9**	**53,453**	**400,603**	**74,856**

2018	Summer Average Day (TPD)			Annual (TPY)		
	VOC	CO	NOx	VOC	CO	NOx
Point Sources	8.2	31.0	114.2	2,901	10,781	38,329
Area Source Emissions	67.9	2.0	3.2	26,452	5,373	2,589
Biogenics[a]	132.0	25.9	5.0	-	-	-
Mobile Sources[b]	51.4	925.5	23.7	10,880	211,485	7,619
On-Road Mobile Sources	42.3	349.9	30.2	12,799	162,695	11,293
Airports	3.5	85.7	24.3	1,286	31,295	8,878
Totals	**305.3**	**1,420.0**	**200.8**	**54,318**	**421,629**	**68,707**

a. Biogenic emissions were estimated for summer average days only.

b. Nonroad mobile includes locomotive emissions.

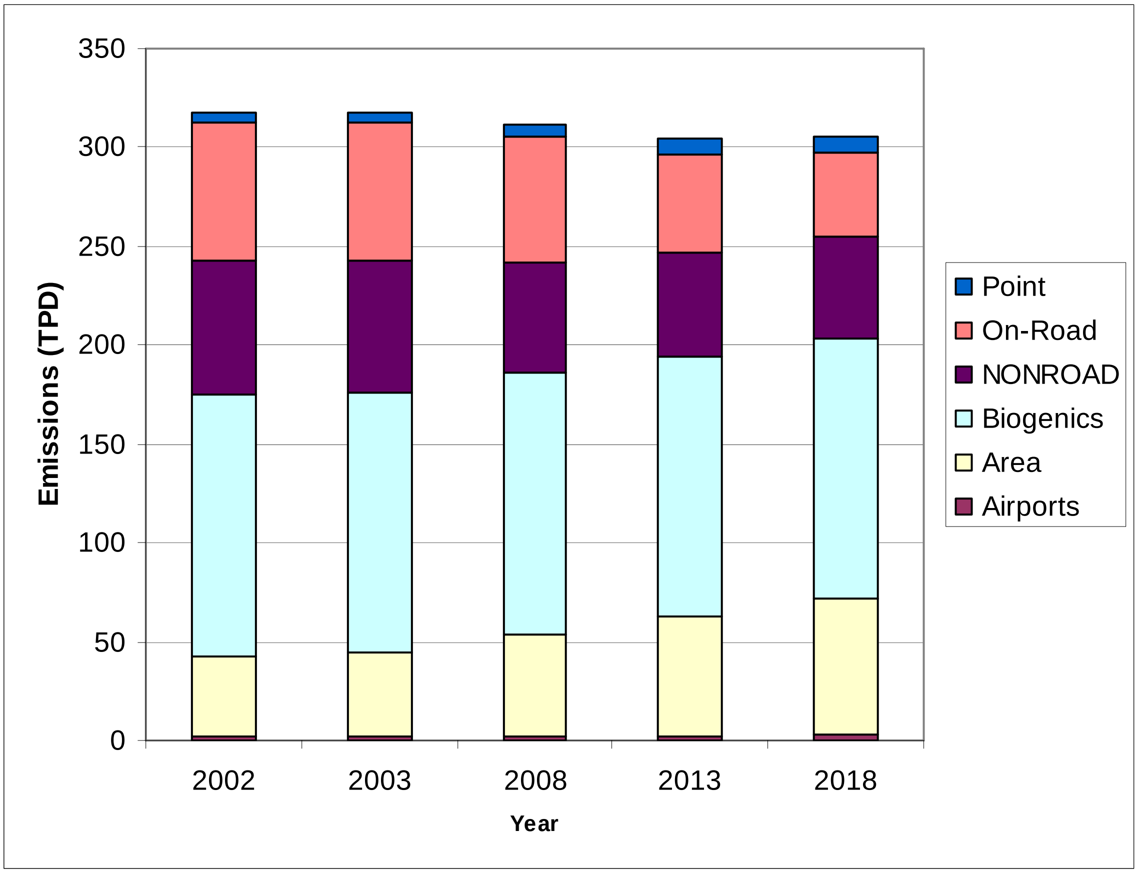

Figure 3-1a. Summer average day VOC emissions by source category, 2002 - 2018.

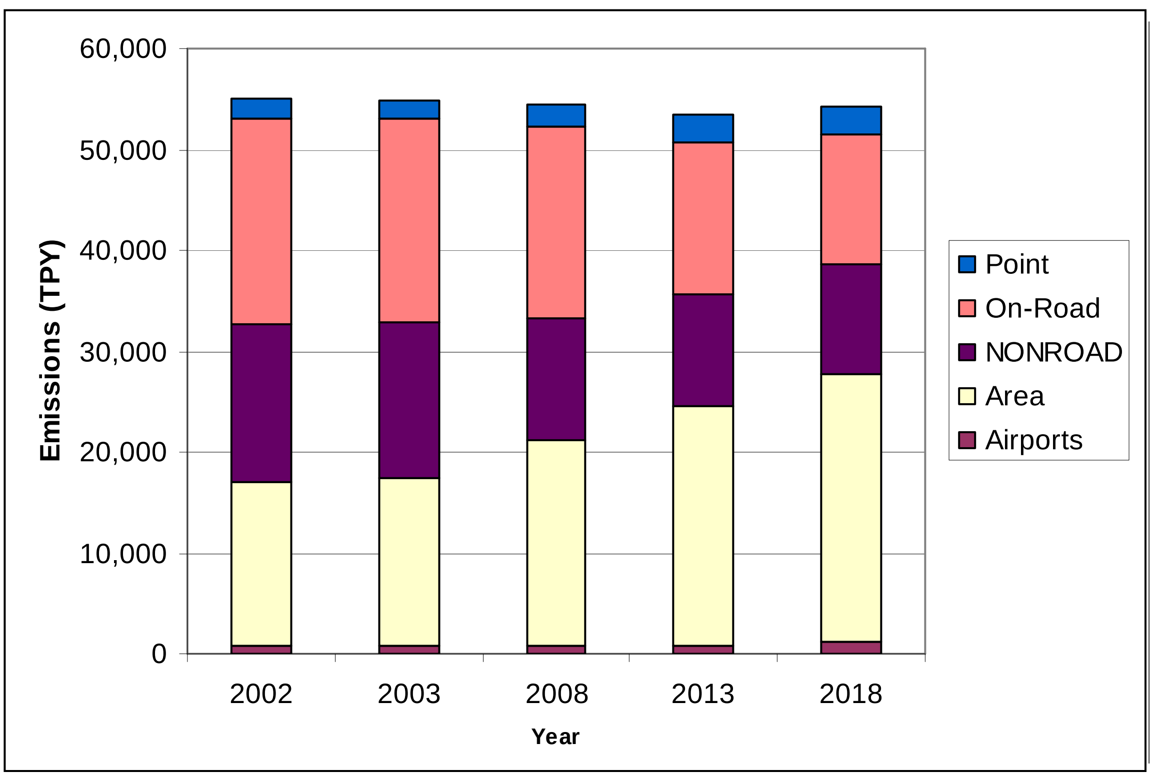

Figure 3-1b. Annual average anthropogenic VOC emissions by source category, 2002 - 2018.

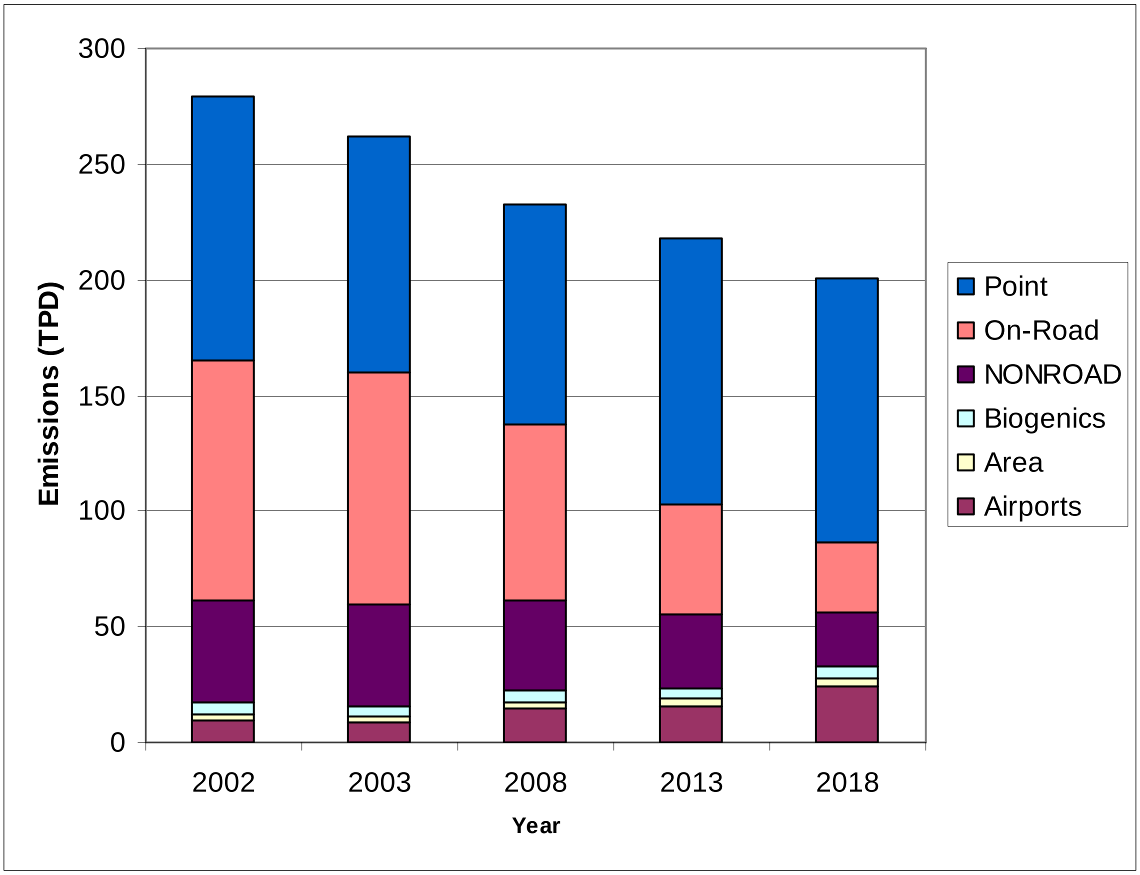

Figure 3-2a. Summer average day NOx emissions by source category, 2002 - 2018.

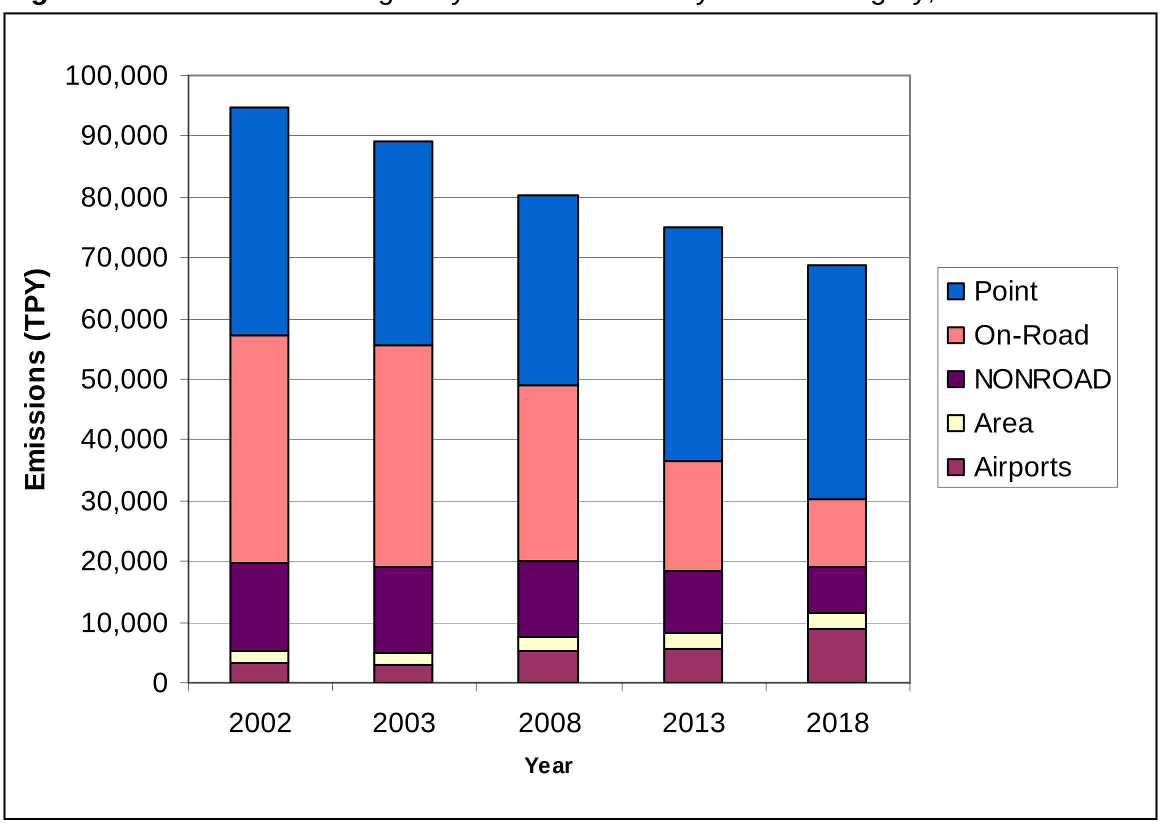

Figure 3-2b. Annual average anthropogenic NOx emissions by source category, 2002 - 2018.

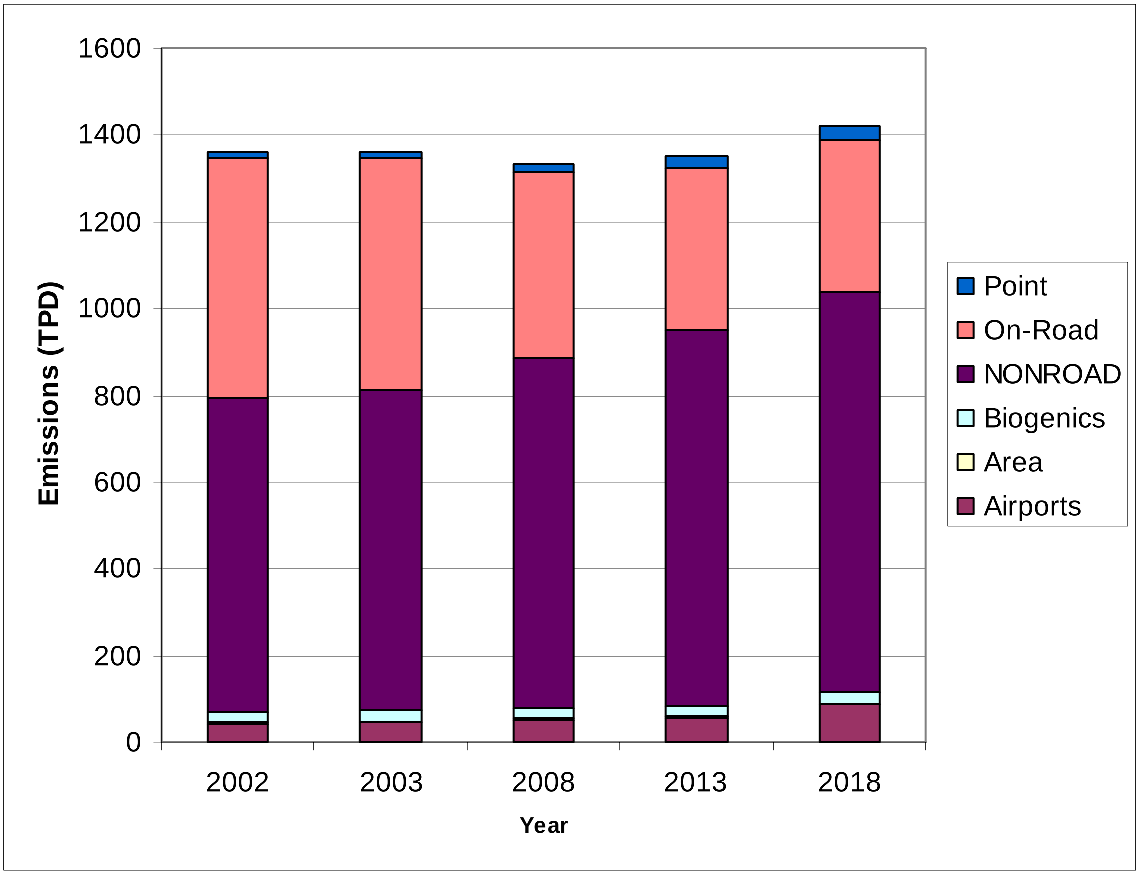

Figure 3-3a. Summer average day CO emissions by source category, 2002 - 2018.

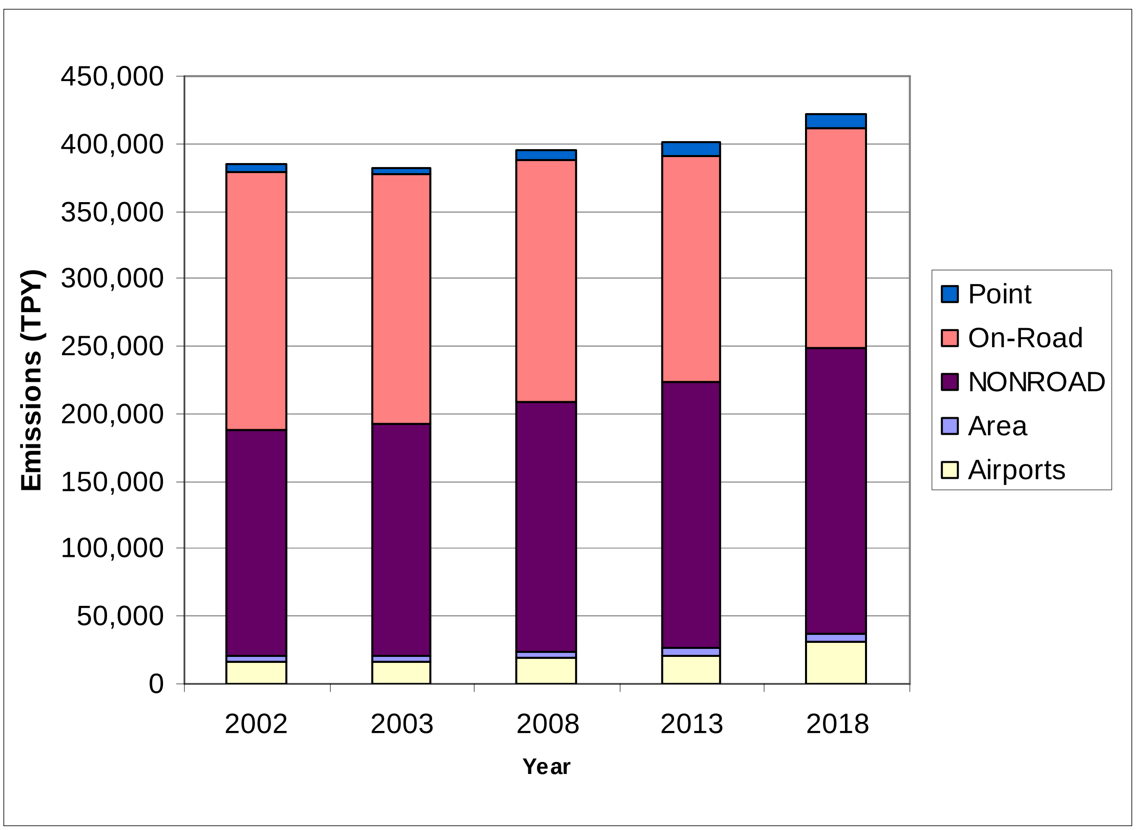

Figure 3-3b. Annual average anthropogenic CO emissions by source category, 2002 - 2018.

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APPENDIX A

Clark County Point & Area Sources Emission Inventory Report

Final Report

CLARK COUNTY POINT AND AREA SOURCE EMISSIONS

Prepared for

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January 2007

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1. INTRODUCTION

This report describes the development of point and area source emission inventories for Clark County, Nevada. The work was done jointly by ENVIRON and Eastern Research Group (ERG), with assistance from Clark County Department of Air Quality and Environmental Management (DAQEM) staff. The emissions for the base and projection years developed in this project were used in the air quality modeling for the Clark County 8-hour ozone State Implementation Plan (SIP).

The scope of the emission inventory described in this report is as follows:

> Source Categories: The point source category includes all facilities emitting more than 10 tons per year (TPY) of volatile organic compounds (VOC) or more than 25 TPY nitrous oxides (NOx). Also included in the point source category are smaller facilities, all hotels and casinos, that DAQEM wished to be modeled as point sources in the SIP air quality modeling. DAQEM compiled the emissions data for all point sources for 2002 and 2003 using data provided by each facility; ERG developed the future year projections.
>
> The area sources category includes numerous disperse stationary sources whose 2002 emissions are smaller than the point source VOC and NOx thresholds. Emissions for the many types of sources in this category were estimated following EPA prescribed procedures, using local activity data where available. Area source emissions for 2002 were developed by ENVIRON; projections factors for future year emissions were developed by ERG.
>
> Geographical Domain: The emissions in this report are estimated for Clark County, Nevada. For the SIP modeling, emissions in the western U.S. outside Clark County were obtained from the Western Regional Air Partnership (WRAP).
>
> Temporal Resolution: Emissions for point and area sources were estimated for 2002 and 2003 base years, and for projection years 2008, 2013, and 2018. For each year, emissions were estimated on an annual basis, and for summer and winter average days.
>
> Pollutants: Emissions were estimated for point and area sources for all criteria and visibility-related pollutants: VOC, NOx, carbon monoxide (CO), particulate matter less than 10 microns (PM10), particulate matter less than 2.5 microns (PM2.5), ammonia (NH3), and sulfur oxides (SOx). Emissions of hazardous air pollutants were also estimated.

Section 2 of this report describes the 2002 point source emission inventory; detailed tables are included with the emissions for all major point sources. Section 3 describes in detail the methods, data, and assumptions used to estimate all area source emissions; example calculations for each source category are provided, along with summary charts showing the contributions of each source grouping to the overall area source emission inventory. Section 4 describes the methods used and provides results of the future year projection emission inventories developed for point and area sources; detailed summary tables are provided that show the total annual emissions for the criteria air pollutants. Emissions for base and future years for the hazardous air pollutants (HAPs) are not provided in this report, but are contained within spreadsheets that have been provided to Clark County DAQEM.

Table 1-1 provides a summary of the point and area source emissions for each year evaluated, for both the annual total and summer average day. The table also provides the percent increase in emissions from 2002 to 2018. Las Vegas has been growing very rapidly, and is projected to continue to grow rapidly. Emissions for those sources that are not heavily controlled, such as area source VOC emissions, thus have a large increase from 2002 to 2018. Point source NOx emissions, on the other hand, and largely controlled and thus the increase in emissions over time is very small.

Table 1-1. Point and area source emission totals, annual and summer average days, 2002 through 2018.

	Summer Average Day (TPD)			Annual (TPY)		
	VOC	**CO**	**NOx**	**VOC**	**CO**	**NOx**
2002						
Point Sources	5.2	15.5	114.4	1,840	5,303	37,549
Area Source Emissions	40.5	1.4	2.6	16,267	4,708	1,904
Total	**45.7**	**16.9**	**117.0**	**18,107**	**10,011**	**39,453**
2003						
Point Sources	4.7	15.2	101.9	1,674	5,147	33,555
Area Source Emissions	42.1	1.4	2.6	16,789	4,541	1,870
Total	**46.9**	**16.5**	**104.5**	**18,463**	**9,688**	**35,425**
2008						
Point Sources	5.8	20.3	95.7	2,028	6,884	31,378
Area Source Emissions	51.4	1.6	2.7	20,378	5,043	2,129
Total	**57.2**	**21.9**	**98.5**	**22,406**	**11,927**	**33,507**
2013						
Point Sources	7.5	29.5	115.0	2,678	10,227	38,477
Area Source Emissions	60.3	1.8	2.9	23,665	5,207	2,355
Total	**67.8**	**31.3**	**117.9**	**26,343**	**15,433**	**40,832**
2018						
Point Sources	8.2	31.0	114.2	2,901	10,781	38,329
Area Source Emissions	67.9	2.0	3.2	26,452	5,373	2,589
Total	**76.0**	**32.9**	**117.5**	**29,353**	**16,154**	**40,917**
Percent increase, 2002 to 2018						
Point Sources	58%	100%	0%	58%	103%	2%
Area Source Emissions	67%	45%	25%	63%	14%	36%

2. CLARK COUNTY 2002 POINT SOURCE EMISSIONS

Table 2-1 lists the 63 point source facilities operating in Clark County in 2002. These include major sources (i.e., emitting 10 tons of VOC or 25 tons of NO_x annually) plus certain other emitters of ozone precursor selected by DAQEM to be included in the point source inventory for this project (e.g., hotels/casinos). This table does not include the 2002 emissions for the airports/airfields located in Clark County (McCarran Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, and Perkins Airfield), since these emissions were estimated and reported by another contractor under a separate contract. However, emissions from these airport/airfields will be included in the modeling analysis along with emissions from other point sources described in this section.

The DAQEM compiled the annual point source emissions inventory for these facilities for 2002 and 2003 (i.e., the later year was used as the baseline for projecting to the future years; see Section 4.0 of this report). The emissions compiled and provided to this project by DAQEM included NO_x, SO_2, VOC, CO, PM_{10}, and NH_3. No 2002 point source emissions were provided for HAPs, so these are not included in this analysis discussed in this section of the report.

The information reported below pertaining to the data and estimation methods used to compile the inventory is based on an interview with DAQEM staff (Doyle, 2006a). The 2002 inventory results summarized at the end of this section were provided by DAQEM (DAQEM, 2006). These results reflect a recent correction by DAQEM to the emissions for five facilities to reflect the impacts (i.e., increases in emissions) to account for rule effectiveness, as well as a change to VOC emissions for Lasco Bathware (ID 0075).

METHODOLOGY OVERVIEW

The 2002 point source emissions were compiled by DAQEM using data submitted by each facility in an annual "Emissions Inventory Report." The 2002 emissions data were submitted to DAQEM by each major source no later than the end of March 2003. An example page, for a selected emission unit, from an Emissions Inventory Report form is shown in Figure 2-1.

After receiving the annual Emissions Inventory Report from a facility, the DAQEM emissions analyst quality assured the emissions estimate as follows:

- Mass balance was used to verify activity data (e.g., SO_2 emissions from natural gas combustion).
- Emission factors were verified (e.g., checked against AP-42); continuous emissions monitor (CEM) data had preference over source test data, and source test data (or emission factors developed from them) had preference over AP-42 emission factors.
- Georeference data (e.g., stack locations) and stack parameters (e.g., stack exit temperature, height, diameter, and flow rate) were verified, and many cases were gap filled using information obtained from other departments within DAQEM, such as permitting..

In cases where activity data, emission factors, or calculations could not be verified, then the DAQEM emissions analyst made a new calculation(s) and estimate(s) of emissions. For example, a common error found in the 2002 Emissions Inventory Reports was missing emission factors. To supplement this information and verify the reported emissions, the DAQEM emissions analysis would back-calculate an emission factor/rate and check this against either AP-42 or the emission rate(s) allowed or otherwise stipulated in the facility's operating permit. If the back-calculated emission factor/rate could not be verified, then the correct emission factor/rate was used to re-calculate a new emissions estimate for the facility. In these cases, the detailed calculations performed by the DAQEM emissions analyst were recorded and placed in the individual facility emission inventory files, which are kept at the DAQEM offices.

After duplicating or revising the emissions inventory data, the DAQEM engineer entered the resulting emissions into the *Emissions Inventory Information Management System (EIIMS) View Version 0.3.925* software package. Although *EIIMS View* has the capability of internally calculating the emissions (i.e., based on user-provided activity data and user-selected emission factors, etc.), the DAQEM emissions analyst performed all emission verification calculations external of *EIIMS View* for 2002, and then entered the results into *EIIMS View* for data management and reporting.

2002 POINT SOURCE EMISSIONS RESULTS

Table 2-2 summarizes the 2002 Clark County point source inventory. These point sources include the major ozone-precursor emitting sources located with Clark County, as well as other sources selected by DAQEM to be included in the point source inventory for this project (e.g., hotels/casinos).

The most significant VOC emitting point source facilities are Kinder Morgan (CalNev Pipeline), Lasco Bathware, Nellis Air Force Base, the Mohave power plant, and Creel Printing. These facilities emit approximately 68 percent (or 1,259 tons) of the total point source VOC emissions, combined. The most significant NO_x emitting point source facilities are three power plants: Mohave, Reid-Gardner, and Clark Station. These power plants emit nearly 90 percent (or 33,402 tons) of the total point source NO_x emissions, combined. The Mohave power plant alone emits more than 53 percent (or approximately 20,000 tons) of the total point source NO_x emissions. The most significant CO emitting point source facilities are Nellis Air Force Base, the Mohave power plant, Chemical Lime and Granite Construction Company, the Reid-Gardner and Clark Station power plants, and PABCO. These facilities emit approximately 83 percent (or 4,382 tons) of the total point source CO emissions, combined. The most significant SO_2 emitting point source is the Mohave power plant (i.e., 94 percent of the total SO_2 from point sources, or 40,346 tons). The most significant PM_{10} emitting point source facilities are the Reid-Gardner and Mohave power plants. These two power plants emit nearly 72 percent (or 3,411 tons) of the total point source PM_{10} emissions, combined. Of the seven point sources for which NH_3 emissions were compiled, the majority of emissions (86 percent or 186 tons) were emitted by the El Dorado Energy power plant, and the two Nevada Cogeneration Associates plants.

In terms of Standard Industrial Category (SIC), these categories emit the most (i.e., 75 percent or greater) of the total point source emissions for each pollutant:

- VOC: Petroleum Bulk Stations and Terminals; Plastics/Plumbing Fixtures; Electric Services; National Security/Armed Services; and Commercial Print/Lithographic.
- NO_x: Electric Services.

- CO: Electric Services; National Security/Armed Services; and, Stone, Clay Glass and Concrete/Gypsum.
- SO_2: Electric Services.
- PM_{10}: Electric Services.
- NH_3: Electric Services/Cogeneration; and, Electric Services..

In summary, the most significant group of point sources emitting ozone precursors is the electric services sector, with the Mohave power plant being the most significant individual facility across all pollutants, excluding NH_3.

Table 2-1. 2002 Clark County point sources (excluding airports/airfields).

Facility ID (Descending)	Primary SIC	Facility Name
0004	3275	BPB Gypsum Blue Diamond
0011	3275	PABCO Building Products and Sandia
0019	3339	TIMET (Titanium Metals)
0138	1446	J R Simplot Company
0360	4931	Nevada Cogeneration Associates #1
0391	4931	Nevada Cogeneration Associates #2
0423	4911	Nevada Sun Peak Partnerships
0393	4931	Saguaro Power Company
0013	5171	Kinder Morgan, CalNev Pipeline
0652	4911	El Dorado Energy
0593	3275	Georgia Pacific
0395	4953	Republic Dumpco
0003	3275	Chemical Lime and Granite Construction Company
0154	3299	Royal Cement
0114	9711	Nellis Air Force Base
15033	4953	Republic Services Sunrise
0075	3088	Lasco Bathware
0402	4952	City of Las Vegas (WPCF)
0859	3086	Universal Urethane
1536	2752	Creel Printing
AP49110398/0007[a, b]	4911	Nevada Power Company (Clark Station)
AP49110399/0008[a, b]	4911	Nevada Power Company (Sunrise Station)
AP49110400[a]	4911	Nevada Power Company (Reid-Gardner)
AP49110466[a]	4911	Southern California Edison (Mohave)
0533	4911	Nevada Power Company (Harry Allen)
0468	4922	Kern River - Goodsprings
0329	4911	Las Vegas Cogen
0012	1442	Wells Cargo, Inc.
0323	2672	Catalina Plastic and Coating
0347	2672	Morgan Adhesive
0482	2434	Capital Cabinets
0897	2752	Berlin Industries
1540	3089	Tsuda Surface Technologies
0886	3479	Applied Hardcoatings
0047	7011	Circus Circus Hotel and Casino
0074	7011	Monte Carlo Hotel and Casino
0086	7011	Riviera Hotel and Casino
0133	7011	Sahara Hotel and Casino

Facility ID (Descending)	Primary SIC	Facility Name
0257	7011	Harrah's Las Vegas
0282	7011	Mirage/ Treasure Island
0825	7011	MGM Grand/New York New York
0564	7011	Stratosphere Hotel and Casino
0610	7011	Westward Ho Hotel and Casino
0613	7011	Imperial Palace Hotel and Casino
0737	7011	Mandalay Bay Resort and Casino
0856	7011	Luxor Hotel and Casino
0609	7011	Excalibur Hotel and Casino
0697	7011	Venetian Hotel and Casino
0756	7011	Bellagio/Boardwalk Hotel and Casino
0026	7011	Aladdin Hotel and Casino
0153	7011	Tropicana Hotel and Casino
0256	7011	Bally's Hotel and Casino
0749	7011	Paris Hotel and Casino
0276	7011	Caesar's Palace Hotel and Casino
0603	7011	Las Vegas Club
0085	7011	Horseshoe Club
0077	7011	Fremont Hotel
0155	7011	Plaza Hotel
0073	7011	Flamingo Hilton
0081	7011	Golden Nugget
0076	7011	Four Queens Hotel and Casino
0434	7011	Fitzgerald’s
0611	7011	Barbary Coast

[a] The EGU(s) at this facility is(are) under State of Nevada jurisdiction.

[b] Non-EGU emission units at this facility are under Clark County jurisdiction (e.g., backup generators, diesel fire pumps, etc.) and have separate Facility Identifier numbers (i.e., 0007 for Clark Station and 0008 for Sunrise).

2002 AIR EMISSIONS INVENTORY – Revision 1
IDENTIFICATION NUMBER

Process B: Emergency Fire Pump

Point ID and Description:
Emissions Unit Number: B01
Description: Emergency Diesel Fire Pump (Detroit Diesel, 300 hp)
SCC Code: 20200101
Total Operating Hours for 2002: 32.43
Throughput: 178.3 gallons based on 7 GPH average
Fuel: Diesel
Power in hp: 300

Pollutant	Emissions Factors (lb/hr)	Control Device	Control Efficiency	2002 Emissions (TPY)
Carbon Monoxide (CO)	4.63 (Manufacturer's Guarantee)	None	0.00%	0.08
Nitrogen Oxides (NO_x)	1.31 (Manufacturer's Guarantee)	None	0.00%	0.02
Particulate Matter < 10 Microns (PM_{10})	2.2E-3 lb/hp-hr (AP-42)	None	0.00%	0.01
Sulfur Oxides (SO_x)	1.19 (Manufacturer's Guarantee)	Diesel Fuel with Sulfur Content < 0.05%	0.00%	0.02
Volatile Organic Compounds (VOCs)	0.22 (Manufacturer's Guarantee)	None	0.00%	0.00
HAPS	Permit	None		0.0001

Note: A Rented Diesel Generator consumed 3,525 gallons (based on fuel delivery invoices) as reported on the Garnet Valley Quarterly Reports submitted to the DAQM.

Figure 2-1. Example page from a 2002 Emission Inventory report.

Table 2-2. 2002 Clark County point source emissions (tons).

Facility Identifier	Facility Name (Alphabetical)	VOC	NOx	CO	SOx	PM10	NH3
0026	Aladdin Hotel and Casino	0.29	2.70	4.56	0.03	0.41	
0886	Applied Hardcoatings	64.12					
0256	Bally's Hotel and Casino	4.02	12.21	7.72	0.28	3.90	
0611	Barbary Coast	0.02	0.18	0.11	-	0.05	
0756	Bellagio/Boardwalk Hotel and Casino	0.93	8.92	8.55	0.23	0.94	
0897	Berlin Industries	31.20	0.74	0.62		0.06	
0004	BPB Gypsum Blue Diamond	13.38	59.49	73.74	0.83	83.87	
0276	Caesar's Palace Hotel and Casino	1.84	11.35	2.75	0.37	6.35	
0482	Capital Cabinets	13.67					
0323	Catalina Plastic and Coating	11.12	0.23	0.39		0.03	
0003	Chemical Lime and Granite Construction Co.	19.02	1,128.40	643.08	180.00	229.97	
0047	Circus Circus Hotel and Casino	2.88	11.40	12.97	0.36	4.76	
0402	City of Las Vegas (WPCF)	38.54	24.83	62.85	12.96	4.28	0.16
1536	Creel Printing	82.20	0.93	0.01	0.35	0.08	
0652	El Dorado Energy	3.70	131.61	4.86	7.28	56.99	97.00
0609	Excalibur Hotel and Casino	1.54	4.95	4.76	0.25	2.00	
0434	Fitzgeralds	0.27	3.76	4.30	0.06	0.35	
0073	Flamingo Hilton	1.23	5.15	7.54	0.09	3.51	
0076	Four Queens Hotel and Casino	0.23	3.64	0.30	-	0.26	
0077	Fremont Hotel	0.53	4.93	7.98	0.06	0.93	
0593	Georgia Pacific	9.21	40.66	161.67	1.03	41.52	
0081	Golden Nugget	0.32	1.72	1.09	0.13	0.74	
0257	Harrah's Las Vegas	0.23	3.91	0.89	0.04	0.61	
0085	Horseshoe Club	0.48	4.41	7.19	0.06	1.81	
0613	Imperial Palace Hotel and Casino	4.55	10.97	14.03	0.17	1.59	
0138	J R Simplot Company	4.95	163.70	2.82	48.53	68.61	
0468	Kern River - Goodsprings	18.37	33.00	1.69	1.82	0.64	
0013	Kinder Morgan, CalNev Pipeline	512.81	0.24	0.08	0.02	0.02	
0603	Las Vegas Club	0.10	1.99	1.62	0.02	0.21	
0329	Las Vegas Cogen	1.48	31.50	5.83	0.17	5.95	7.30
0075	Lasco Bathware	306.41	1.17	0.20		0.04	
0856	Luxor Hotel and Casino	1.10	6.40	9.89	0.12	4.55	

Facility Identifier	Facility Name (Alphabetical)	VOC	NOx	CO	SOx	PM10	NH3
0737	Mandalay Bay Resort and Casino	1.59	29.10	23.70	0.19	4.05	
0825	MGM Grand/New York New York	8.71	32.47	33.82	0.78	20.17	
0282	Mirage/ Treasure Island	1.39	15.80	12.78	0.29	3.10	
0074	Monte Carlo Hotel and Casino	0.36	4.36	5.26	0.06	0.49	
0347	Morgan Adhesive	16.39	2.26	0.47	0.01	0.07	
0114	Nellis Air Force Base	219.15	592.72	1,332.67	77.14	122.49	
0360	Nevada Cogeneration Associates #1	22.70	101.78	34.93	1.66	19.64	56.76
0391	Nevada Cogeneration Associates #2	23.74	108.24	34.60	1.72	20.65	32.72
AP49110398/0007	Nevada Power Company (Clark Station)	33.56	4,229.75	403.31	9.29	243.84	
0533	Nevada Power Company (Harry Allen)	0.52	6.55	6.05	0.30	4.91	
AP49110400	Nevada Power Company (Reid-Gardner)	58.00	9,160.90	483.40	1,977.80	1,756.09	
AP49110399/0008	Nevada Power Company (Sunrise Station)	9.08	885.11	143.82	1.16	15.48	
0423	Nevada Sun Peak Partnerships	1.84	127.47	6.73	0.09	5.11	
0011	PABCO Building Products and Sandia	49.15	212.57	346.91	9.52	78.41	
0749	Paris Hotel and Casino	2.28	13.65	23.45	0.33	7.55	
0155	Plaza Hotel	0.78	8.76	9.80	0.17	1.22	
0395	Republic Dumpco	3.67	26.54	7.56	48.16	171.53	
15033	Republic Services Sunrise	1.90	2.63	6.53	67.37	0.56	
0086	Riviera Hotel and Casino	0.41	8.94	5.89	0.08	0.55	
0154	Royal Cement	1.37	120.00	8.00	16.00	8.50	4.75
0393	Saguaro Power Company	6.90	88.95	12.36	0.04	5.41	17.26
0133	Sahara Hotel and Casino	0.36	4.89	4.04	0.01	0.06	
AP49110466	Southern California Edison (Mohave)	138.00	20,011.00	1,173.00	40,346.00	1,655.00	
0564	Stratosphere Hotel and Casino	3.95	22.08	24.78	0.49	5.13	
0019	TIMET (Titanium Metals)	2.05	2.55	71.25	2.08	33.27	
0153	Tropicana Hotel and Casino	0.64	6.02	9.30	2.27	2.27	
1540	Tsuda Surface Technologies	30.45	3.60	1.45	0.05	0.26	
0859	Universal Urethane	39.70	-	-	-	-	

ENVIRON

Facility Identifier	Facility Name (Alphabetical)	VOC	NOx	CO	SOx	PM10	NH3
0697	Venetian Hotel and Casino	-	0.43	0.09	-	0.03	
0012	Wells Cargo, Inc.	11.00	4.50	22.30	0.60	36.00	
0610	Westward Ho Hotel and Casino	0.04	0.66	0.34	0.01	0.51	
TOTAL		**1,840.43**	**37,549.36**	**5,302.67**	**42,818.92**	**4,747.38**	**215.95**

3. CLARK COUNTY 2002 AREA SOURCE EMISSIONS

This section describes in detail all of the calculations, source data, and assumptions used to estimate all area source emissions. For each source category, example calculations are also provided. All calculation spreadsheets and all activity data used in the emissions estimates have been provided to Clark County DAQEM. At the end of the section, summary graphs are provided that show the contribution of each source category to total area source emissions for each of the major pollutants.

GRAPHIC ARTS

Annual Emissions

To estimate annual VOC emissions from graphic arts, a national per-capita emission factor of 1.3 lbs VOC/person-year (EIIP, 1996a) was applied to the estimated 2002 Clark County population: 1,578,332 people (Clark County Comprehensive Planning, 2005). HAP emissions were then determined by applying a speciation profile (Table 3-1) to the VOC emissions. Speciate profile 2570 from EPA's SPECIATE 3.2 database (Graphic Arts – Composite of Lithography, Rotogravure, Letterpress and Flexography) was selected over profiles 1191 and 1086, due to the more recent development of profile 2570. Profile 2570 is based upon emissions data collected in 1993, where profiles 1191 and 1086 are based upon 1978 and 1985 data respectively (U.S. EPA, 2002a).

Table 3-1. HAP Speciation profile for graphic arts.

HAPS	% of Total VOC
Benzene	1.94
Ethyl benzene	0.27
Methyl ethyl ketone	7.97
methyl Isobutyl Ketone	2.17
Toluene	11.28
M-Xylene and P-Xylene	0.81
O-Xylene	0.45

(U.S. EPA, 2002a)

Seasonal Emissions

EIIP documentation suggests that while graphic arts shops show no appreciable seasonal variation, typically 75% of emissions activity occurs on weekdays (EIIP, 1996a).

Sample Calculations

$E_{VOC} = P * EF_{VOC} / 2000lb/ton$
$E_{benzene} = E_{VOC} * S_{benzene}$

where: E_{VOC} = Annual emission of VOC (tons/year)
$E_{benzene}$ = Annual emission of benzene (tons/year)
P = 2002 Population
EF_{VOC} = VOC per-capita emission factor (lb/person/year)
$S_{benzene}$ = Percent total of VOC emission that is benzene

A sample calculation using this equation for estimating VOC and benzene emissions for graphic arts is as follows:

where: P = 1,578,332 people
EF_{VOC} = 1.3 lbs VOC/person-year
$S_{benzene}$ = 1.94%.

E_{VOC} = P * EF_{VOC} / 2000lb/ton
E_{VOC} = 1,578,332 * 1.3 /2000 = 1,026 ton/year;

$E_{benzene}$ = E_{VOC} * $S_{benzene}$
$E_{benzene}$ = 1,025.9 * .0194 = 19.9 ton/year;

AUTO BODY REFINISHING

Annual Emissions

VOC emissions originating in auto body refinishing operations were estimated using a per employee emission factor. The emission factor of 759.6 lbs/employee-year (EIIP, 2000a) was applied to Clark County employment in NAICS 811121 (Automotive body paint & interior R&M). Clark County employment for 2002 was obtained from *County Business Patterns* (U.S. Census Bureau, 2005). In cases where employment data was given as a range, employment was estimated to be the average of the two extremes (e.g. given range = 0 – 19, value used = 9.5).

Annual emissions of HAPs were then estimated using the speciation profiles from EPA's SPECIATE 3.2 database (U.S. EPA 2002b, U.S EPA 2002c). Two profiles are present in SPECIATE 3.2 that apply to this category, profiles 2402 and 1194. The profiles were combined to obtain the most comprehensive list of HAPs. Where a pollutant was listed in both profiles, the value given in profile 2402 was used due to its derivation from more recent studies.

For VOC emissions, a 33 percent reduction was applied to reflect the promulgation of national VOC rules. This is the estimated total reduction of VOCs emanating from auto body refinishing to be achieved by the national VOC rule (Federal Register, 1998a). Given that HAP emissions are based on speciation of VOCs, they too were diminished by 33 percent.

Seasonal Emissions

Average summer and winter weekday emissions can be calculated by dividing the annual emissions by 260 workdays/year. EIIP documentation suggests that auto body refinishing shops typically operate five days per week and that emissions are not seasonally variable (EIIP, 2000a).

Sample Calculations

$E_{VOC} = CE * EF_{VOC} * (1.0 – 0.33)$
$E_{BENZENE} = E_{VOC} * S_{BENZENE}$

where: E_{VOC} = Annual Emission of VOC from auto body refinishing (tons/year)
$E_{benzene}$ = Annual Emission of benzene from auto body refinishing (tons/year)
CE = County Employment
EF_{VOC} = VOC per-employee emission factor
$S_{benzene}$ = Percent-weight of VOC that is benzene

A sample calculation using this equation for estimating VOC and Benzene for autobody refinishing is:

where: CE = 929 employees
EF_{VOC} = 759.6 lbs VOC/employee-year
$S_{benzene}$ = 1.51%

$E_{VOC} = CE * EF_{VOC} * (1.0 – 0.33)$
E_{VOC} = 929 * 759.6 * (1.0 – 0.33) / 2000 lb/ton = 236.4 ton/year

$E_{BENZENE} = E_{VOC} * S_{BENZENE}$
$E_{BENZENE}$ = 236.4 * 0.0151 = 3.57 ton/year

DRY CLEANING

Annual Emissions

VOC emissions originating in dry cleaning operations were estimated using a per employee emission factor. The emission factor of 1800 lbs/employee-year (EIIP, 1996b) was applied to county level employment in NAICS 812320 (Dry cleaning and laundry services, except coin-operated). Clark County 2002 employment was obtained from *County Business Patterns* (U.S. Census Bureau, 2005). In cases where the employment was given as a range, employment was estimated to be the average of the two extremes (e.g. given range = 0 – 19, value used = 9.5).

Annual emissions of HAPs were estimated using an employment-based emission factor for total halogenated solvents (THS). The halogenated solvents in question are perchloroethylene (also PERC or tetrachloroethene), 1,1,1-trichloroethane (also TCA or methyl chloroform) and CFC-113. To extract the emission factors for the relevant pollutants, PERC and TCA, from this combined factor, survey data of the national consumption of each solvent was used. Based on a national survey, 39% of solvents used are PERC, 3% are TCA and 1% are CFC-113 (EIIP, 1996b). Therefore, 90.7% of the THS emission factor was assumed to apply to PERC and 6.9% to TCA (see calculation below). The emission factors resulting from this process are shown in Table 3-2.

Table 3-2. HAP Emission factors for dry cleaning.

Solvent	**THS Emission Factor** (EIIP, 1996b)	**% of Total Use** (EIIP, 1996b)	**% of THS**	**Pollutant-Specific Emission Factor**
mineral spirits		57		
PERC	980 lb/employee-yr	39	90.7	889
TCA		3	6.98	68.4
CFC-113		1	2.33	

These employment based emission factors for PERC and TCA were applied to Clark County employment for both NAICS 812320 and NAICS 812310. NAICS 812310 was included in the calculation for HAPs and not for VOCs because coin-operated dry cleaners use PERC only. PERC is not considered photochemically reactive and is therefore not included in ozone VOC inventories, so coin-operated dry cleaners cannot be included in VOC calculations (EIIP, 1996b). Emissions resulting from activity in NAICS 812310 are reported under SCC 2420020000 and those resulting from activity in NAICS 812320 are reported under SCC 2420010000.

Emission reductions resulting from the 1993 promulgation of the National Emission Standards for Hazardous Air Pollutants (NESHAP) rule, “Perchloroethylene Dry Cleaning Facilities” (40 CFR, Parts 963) were incorporated into emission estimates. 40 CFR, Parts 963 requires the control of dry cleaning PERC emissions to the level of maximum achievable control technology (MACT). A PERC emission reduction that corresponds to approximately 44 percent of the total 1996 PERC emissions from all existing dry cleaning facilities and a 43 percent reduction (40 CFR, Parts 963) in 1996 from all new dry cleaning facilities were estimated nationwide as a result of rule implementation. Additionally, dry cleaning EIIP documentation states that, "Coin-op dry cleaning units are exempt from all but the initial reporting NESHAP requirements." (EIIP 1996b) Therefore, a reduction of 43% (conservatively estimated to be the lesser of 43% and 44%) was applied to all PERC HAP emissions; with the emissions reduction reflected only in the non-coin-op dry cleaners reported PERC emissions (SCC 2420010000).

Seasonal Emissions

There is no seasonal variation of dry cleaning emissions, and a 5 day/week operation schedule can be assumed (EIIP, 1996b). Average summer and winter weekday emissions can be calculated by dividing the annual emissions by 260 workdays/year.

Sample Calculations

$E_{VOC} = EM_{812320} * EF_{VOC} / 2000 \text{ lb/ton}$
$E_{PERC,812310} = EM_{812310} * EF_{THS,812310} / 2000 \text{ lb/ton}$
$E_{PERC,812320} = [(EM_{812310})*EF_{THS,812320}*P_{PERC}/(P_{PERC}+P_{TCA}+P_{CFC})/2000 \text{ lb/ton} + E_{PERC,812310}]*(1-ER)-E_{PERC,812310}$

where: $EF_{THS,812310}$ = Coin-op dry cleaning total halogenated solvent (THS) emission factor (lbs/employee-year)
$EF_{THS,812320}$ = Commercial or industrial dry cleaning total halogenated solvent (THS) emission factor (lbs/employee-year)
P_{PERC} = Percent of total solvent use that is PERC = 39%
P_{TCA} = Percent of total solvent use that is TCA = 3%
P_{CFC} = Percent of total solvent use that is CFC-113 = 1%
EF_{PERC} = PERC emission factor
E_{VOC} = Annual Emission of VOC from dry cleaning (tons/year)
E_{PERC} = Annual Emission of PERC from dry cleaning (tons/year)
$E_{PERC,812310}$ = Annual Emission of PERC from coin-op dry cleaning (tons/year)
$E_{PERC,812320}$ = Annual Emission of PERC from commercial or industrial dry cleaning (tons/year)
EF_{VOC} = VOC emission factor (lbs/employee-year)
EM_{812310} = 2002 coin-op dry cleaning employment (NAICS 812310) employment
EM_{812320} = 2002 commercial or industrial dry cleaning employment (NAICS 812310) employment
ER = PERC emissions reduction due to 1993 NESHAP rule

A sample calculation using these equations for estimating VOC and PERC for dry cleaning in Clark County is:

where: EF_{VOC} = 1800 lbs VOC/employee-year
$EF_{THS,812310}$ = 52 lbs halogenated solvents/employee-year
$EF_{THS,812320}$ = 1,200 lbs halogenated solvents/employee-year
EM_{812310} = 234 employees
EM_{812320} = 1245 employees
ER = 0.43

$E_{VOC} = EM * EF_{VOC} / 2000 \text{ lb/ton}$
$E_{VOC} = 1245 * 1800 / 2000 = 1121 \text{ ton/year}$

$E_{PERC,812310} = EM_{812310} * EF_{THS,812310} / 2000 \text{ lb/ton}$
$E_{PERC,812310} = 234 * 52 / 2000 = 6.1 \text{ tons/year}$

$E_{PERC,812320} = [(EM_{812310})*EF_{THS,812320}*P_{PERC}/(P_{PERC}+P_{TCA}+P_{CFC})/2000 \text{ lb/ton} + E_{PERC,812310}]*(1-ER)-E_{PERC,812310}$
$E_{PERC,812320} = [(1245) * 1200 * 39 / (39+3+1) / 2000 + 6.1] * (1-0.43) - 6.1 = 384 \text{ ton/year}$

RESIDENTIAL OPEN BURNING

Annual Emissions

Residential open burning is restricted by Clark County Air Quality Regulations, Section 42. Open burning is limited to that open burning which has been approved in advance by the Clark County, Air Quality Control Officer (Clark County DAQEM, 2005a). Emissions from open burning were estimated based on records of open burning that was permitted in 2002 (Table 3-3). Only emissions form the open burning of yard trimming waste was estimated because all permitted open burning was associated with materials typically associated with yard trimming waste.

Records of open burning permits issued in Clark County, 2002, offer no quantitative information associated with permits, although qualitative information is available regarding materials to be burned. To estimate the quantity associated with each open burning permit issued assumptions were made based on waste generation rates. It was assumed that each open burning permit issued was associated with the amount of yard trimming waste generated by one household in one year. The national yard trimming waste generation rate, 0.54 lbs/person-day (EPA, 2003a), in 2001, was the most recent available. The national yard trimming waste generation rate was multiplied by the ratio of the total Clark County waste generation rate (7.77 lb/person/day, Nevada DEP, 2005) to the national waste generation rate (4.41 lbs/person/day EPA, 2003a) to estimate the per-capita yard trimming waste generated in Clark County. This estimate was then multiplied by the average Clark County household size (2.65 people, US Census, 2000) to derive an estimate of Clark County yard trimming waste generated per permit.

Table 3-3. Number of open burning permits for Clark County, 2002.

Month	Number of Permits
January	17
February	39
March	23
April	14
May	10
June	3
July	0
August	1
September	2
October	15
November	0
December	0

(Clark County DAQEM, 2005b)

To estimate the type(s) of material burned for each permit, quantitative estimates were made based on qualitative burn material descriptions provided by Clark County DAQEM, 2005b (see Table 3-4).

Table 3-4. Material burned in open burning permits for Clark County, 2002.

Number of 2002 Burn Permits	Permit Descriptions: Material Burned	Estimates of Materials Associated with Permit Descriptions			
		Leaves	Brush	Weeds	Grasses
13	Wood	0%	100%	0%	0%
39	Weeds/Grasses	0%	0%	50%	50%
16	Mixed Weeds/Grasses and Wood	0%	33%	33%	33%
56	Wood and leaves (branches & brush)	50%	50%	0%	0%

(Clark County DAQEM, 2005b)

Having established amount of waste burned per permit, the annual amount of waste subject to burning (see Table 3-5), emissions were determined using emission factors detailed in the EIIP document (EIIP, 2001a) and in the documentation for the 1999 National Emission Inventory for Hazardous Air Pollutants (EPA, 2003b).

Table 3-5. Emission factors for the combustion of yard waste.

Pollutant	Leaves	Brush	Weeds	Grasses
VOC (lb/ton)	28	19	9	15
CO (lb/ton)	112	140	85	101
PM_{10} (lb/ton)	38	17	15	16
$PM_{2.5}$ (lb/ton)	38	17	15	16

Seasonal Emissions

Activity was assumed to occur in accordance with the distribution of permit issuance as shown in Table 3-3. Winter emissions were estimated by the percent of permits issued from December through February and summer emissions were estimated based on permits issued from June through August.

Sample Calculations for Burning of MSW

Sample Calculations for Burning of Yard Wastes, Leaves

$$E_{VOC,LEAVES} = EF_{VOC,LEAVES} * G / 2000 \text{ lb/day}$$
$$G = A * P * H * (N * W_{CC} / W_{NAT}) * 365 \text{ days} / 2000 \text{ lb/ton}$$

where: $E_{VOC,LEAVES}$ = Emission of VOCs from leaves
$EF_{VOC,LEAVES}$ = Emission factor for VOCs released from burning of leaves wastes
G = yard trimming waste generated as leaves (ton/year)
A = number of open burning permits authorized in 2002

P = percent of material burned that is leaves
H = average household size
N = national average yard trimming waste generation rate (lb/year)
W_{CC} = Clark County 2002 total waste generation (lb/person)
W_{NAT} = National 2002 total waste generation (lb/person)

A sample calculation using this equation for estimating VOC for residential open burning of yard waste in Clark County is:

where: $EF_{VOC,LEAVES}$ = 28 lb/ton
A = 124 authorizations
P = 22.6%
H = 2.65 people/household
N = 0.54 lb/day
W_{CC} = 7.77 lb/day
W_{NAT} = 4.41 lb/day

$G = A * P * H * (N * W_{CC} / W_{NAT}) * 365 \text{ days} / 2000 \text{ lb/ton}$
$G = 124 * 22.6\% * 2.65 * (0.54 * 7.77 / 4.41) *365 \text{ days} /2000 \text{ lb/ton} = 12.9 \text{ tons/year}$

$E_{VOC,LEAVES} = EF_{VOC,LEAVES} * G /2000 \text{ lb/ton}$
$E_{VOC,LEAVES} = 28 * 12.89 / 2000 \text{ lb/ton} = 0.18 \text{ ton/year}$

INDUSTRIAL SURFACE COATING

Annual Emissions

VOC emissions originating from industrial surface coating operations were estimated using either per employee emission factors or per capita emission factors. There are actually ten distinct surface coating operations with distinct per employee emission factors and three operations with per capita emission factors, for a total of 13 categories. These operations and the corresponding emission factors are listed in Table 3-6.

Table 3-6. Industrial surface coating SCCs and emission factors.

SCC	Description	Type of Emission Factor	Emission Factor
2401015000	Factory Finished Wood	lb/employee	131
2401020000	Furniture	lb/employee	944
2401040000	Metal Cans	lb/employee	6,029
2401050000	Misc. Finished Metals	lb/employee	2,877
2401055000	Machinery and Equipment	lb/employee	77
2401060000	Appliances	lb/employee	463
2401065000	Electronic/Electrical	lb/employee	290
2401070000	Motor Vehicles	lb/employee	794
2401080000	Marine	lb/employee	308
2401850000	Railroad/Other	lb/employee	35
2401090000	Misc. Manufacturing	lb/person	0.6

SCC	Description	Type of Emission Factor	Emission Factor
2401100000	High Performance Industrial Maintenance Coatings	lb/person	0.8
2401200000	Other Special Purpose Coatings	lb/person	0.8

(EIIP, 1997a)

For each type of operation with a per employee factor, the emission factor was applied to county level employment in numerous NAICS categories. The EIIP document gives source categories with corresponding SIC codes, but given that the most recent *County Business Patterns* use NAICS codes, the corresponding NAICS codes were identified for use (EIIP, 1997a and U.S. Census Bureau, 1998). A complete listing of the NAICS categories by associated SCC is presented in Table 3-7.

2002 Clark County employment by NAICS was obtained from *County Business Patterns* (U.S. Census Bureau, 2005). In cases where a year's employment was given as a range, employment for that year was estimated to be the average of the two extremes (e.g. given range = 0 – 19, value used = 9.5). For the three source categories with per capita emission factors, those factors were applied to the 2002 Clark County population estimate.

Table 3-7. NAICS categories from which industrial surface coating employment activity were drawn.

Factory Finished Wood

SIC	NAICS	SIC	NAICS
2426-2429	32192	243 to 245	321213
2426-2429	321113	243 to 245	321214
2426-2429	321912	243 to 245	321911
2426-2429	321918	243 to 245	321918
2426-2429	321999	243 to 245	321991
2426-2429	337215	243 to 245	321992
243 to 245	33711	2493	321219
243 to 245	321211	2499	333414
243 to 245	321212	2499	339999

Furniture

SIC	NAICS	SIC	NAICS
25	33636	25	337129
25	33791	25	337211
25	33792	25	337212
25	337121	25	337214
25	337122	25	337215
25	337124	25	339111
25	337125	25	339942
25	337127		

Machinery/Equipment

SIC	NAICS	SIC	NAICS
35	33241	35	333515
35	33271	35	333516
35	33312	35	333518

Automobiles

SIC	NAICS	SIC	NAICS
3711	33612	3711	336211
3711	336111	3711	336992
3711	336112		

Sheet/Strip/Coil

SIC	NAICS	SIC	NAICS
3479	332812	3479	339912
3479	339911	3479	339914

Metal Containers

SIC	NAICS
341	332431
341	332439

Appliances

SIC	NAICS	SIC	NAICS
363	333298	363	335222
363	333414	363	335224
363	335211	363	335228
363	335212	363	339999
363	335221		

Other Transportation

SIC	NAICS	SIC	NAICS
37	33633	37	336322
37	33634	37	336399
37	33635	37	336411
37	33651	37	336412

Machinery/Equipment (cont.)			
SIC	**NAICS**	**SIC**	**NAICS**
35	33321	35	333611
35	33322	35	333612
35	33651	35	333613
35	314999	35	333618
35	332212	35	333911
35	332323	35	333912
35	332439	35	333913
35	332991	35	333921
35	332997	35	333922
35	332999	35	333923
35	333111	35	333924
35	333112	35	333991
35	333131	35	333992
35	333132	35	333993
35	333291	35	333994
35	333292	35	333995
35	333293	35	333996
35	333294	35	333997
35	333295	35	333999
35	333298	35	334111
35	333311	35	334112
35	333312	35	334113
35	333313	35	334119
35	333319	35	334418
35	333411	35	334518
35	333412	35	334613
35	333414	35	335311
35	333415	35	336311
35	333511	35	336391
35	333512	35	336399
35	333513	35	339942
35	333514		

Machinery/Equipment (concl.)			
SIC	**NAICS**	**SIC**	**NAICS**
37	54171	37	336413
37	332912	37	336414
37	333911	37	336415
37	333924	37	336419
37	336212	37	336991
37	336213	37	336992
37	336214	37	336999
37	336312		
Marine			
SIC	**NAICS**	**SIC**	**NAICS**
373	48839	373	336611
373	81149	373	336612
Electrical Insulation			
SIC	**NAICS**	**SIC**	**NAICS**
3357	331319	3357	335921
3357	331422	3357	335929
3357	331491	3612	335311

Annual emissions of HAPs were then estimated by applying a speciation profile to the annual VOC emissions of each source category. The available speciation data was divided into two speciation profiles, one for water-borne coatings and another for solvent-borne coatings. The national percentage of sales of each coating type (9% water-borne coatings & 91% solvent borne coatings [U.S. EPA, 2003b]) was used to combine those profiles into a single profile that could be applied to our estimates of total VOC emissions (see calculations below). The resulting speciation profile is shown in Table 3-8.

Table 3-8. Industrial surface coating HAP speciation profile.

Pollutant	Average VOC Weight Fraction		
	In water-borne coatings	In solvent-borne coating	Combined
Acetophenone	-	0.0006	0.0005
Cumene	-	0.0012	0.0011
Dibutyl Phthalate	0.0031	-	0.0003
Ethyl Benzene	-	0.0062	0.0056
Ethylene Glycol	0.1271	0.0048	0.0158
Glycol ethers	0.1434	0.0334	0.0433
Isophorone	-	0.0053	0.0048
Methanol	0.0429	0.0151	0.0176
methyl ethyl ketone	-	0.0065	0.0059
methyl isobutyl ketone	-	0.0162	0.0147
Naphthalene	-	0.0022	0.0020
Toluene	-	0.0118	0.0107
Xylenes (Mixture of o, m, and p Isomers)		0.0348	0.0317

(U.S. EPA, 2003b)

Seasonal Emissions

There is no seasonal variation of industrial surface coating emissions, and a 5 day/week operation schedule can be assumed (EIIP, 1997a).

Sample Calculations

$E_{VOC} = EM * EF_{VOC} / 2000lb/ton$
$E_{EG} = (WB * P_{WB} + SB * P_{SB}) * E_{VOC}$

where: E_{VOC} = Annual Emission of VOC from furniture (tons/year)
E_{EG} = Annual Emission of ethylene glycol from furniture (tons/year)
EM = 2002 county employment in selected NAICS
EF_{VOC} = VOC emission factor
WB = Weight fraction of VOC in water-borne coatings that is ethylene glycol, 0.1271
SB = The weight fraction of VOC in solvent-borne coatings that is ethylene glycol, 0.0048
P_{WB} = Percent of national coating sales that was water-borne coating, 9%
P_{SB} = Percent of national coating sales that was solvent-borne coating, 91%

A sample calculation using this equation for estimating VOC and ethylene glycol for industrial surface coating in Clark County is:

where: EM = 631 employees
EF_{VOC} = 944 lbs VOC/employee-year
WB = 0.1271
SB = 0.0048
P_{WB} = 9%
P_{SB} = 91%

E_{VOC} = EM * EF_{VOC} / 2000lb/ton
E_{VOC} = 631 * 944 /2000 = 297.8 ton/year

E_{EG} = (0.1271 * 0.09 + 0.048 * 0.91) * E_{VOC}
E_{EG} = .0158 * 297.8 = 4.71 ton/year

Similar calculations are performed for population-based estimates with the exception of 2002 county employment being replaced by 2002 county population and the emission factor being lbs/person-year as opposed to lbs/employee-year.

RESIDENTIAL WOOD COMBUSTION

Annual Emissions

The source categories included in residential wood combustion are listed in Table 3-9.

Table 3-9. Residential wood combustion SCCs.

SCC	Description		
2104008001	Residential	Wood	Fireplaces: General
2104008002	Residential	Wood	Fireplaces: Insert; non-EPA certified
2104008003	Residential	Wood	Fireplaces: Insert; EPA certified; non-catalytic
2104008004	Residential	Wood	Fireplaces: Insert; EPA certified; catalytic
2104008030	Residential	Wood	Catalytic Woodstoves: General
2104008051	Residential	Wood	Non-catalytic Woodstoves: Conventional
2104008052	Residential	Wood	Non-catalytic Woodstoves: Low Emitting

The activity level and data on the distribution of equipment types was taken from a survey conducted in 2002 in Washoe County, Nevada (Washoe County, 2002). The Washoe County per capita wood combustion estimate from this survey was normalized by heating-degree-days to yield a per capita wood consumption estimate of 0.027 cords/person-year. Cords/person-year was easily converted to lbs/person-year using the approximate density of one cord of wood burned in Clark County, 1,891 lbs/cord, calculated using information on tree species available for burning (Koepnick, 2005) and density estimates by species available in EIIP documentation (EIIP 2001b).

The average device age of 12 years was estimated based on the distribution of certified and non-certified stoves and inserts reported in the Washoe County Survey (Washoe County, 2002). Based on that age and an assumption of an equal number of equipment purchases each year, the wood burned by stoves and inserts was further distributed into the wood burned by conventional, Phase I and Phase II stoves and inserts. Another adjustment was made to the equipment distribution. The percent of EPA-certified stoves that are catalytic (40%) and non-catalytic (60%) were used to further divide the Phase I and Phase II stove use into a total of eight stove and insert categories, (shown in Table 3-10. This calculation was necessary to use the emission factors for HAPs in the documentation for the 1999 National Emission Inventory for Hazardous Air Pollutants (EPA, 2003b). One further adjustment was made to account for Clark County Regulations (DAQEM, 2002) which specify that the installation of uncontrolled fireplaces after

1991 is generally prohibited. To account for this regulation, the average device age of 12 years was applied to fireplaces. Assuming that Phase II inserts would be installed in place of uncontrolled fireplaces after 1991, fireplaces purchased after 1991 were assumed to be Phase II inserts. A rule effectiveness of 100% was assumed based on Clark County Development Service Department approval of new construction only if a natural gas supply to any residential wood burning device is included.

Table 3-10. Percent of total wood combusted, combusted by device types.

Fireplaces		**24.5%**
Stoves + Inserts		**75.5%**
Avg. device age of 12 years yields:		
Stoves		**27.4%**
Uncontrolled (pre 1990 stoves)	**13.7%**	
Phase I (1990 – 1991 stoves)	**1.2%**	
Catalytic	0.5%	
Non-Catalytic	0.7%	
Phase II (1991 – 2002 stoves)	**12.6%**	
Catalytic	5.0%	
Non-Catalytic	7.0%	
Inserts		**48.1%**
Uncontrolled (pre 1990 inserts)	**13.7%**	
Phase I (1990 – 1991 inserts)	**1.2%**	
Catalytic	0.5%	
Non-Catalytic	0.7%	
Phase II (1991 – 2002 inserts)	**33.2%**	
Catalytic	19.9%	
Non-Catalytic	13.3%	

The annual combustion of wood by these equipment types was then estimated by multiplying the per-capita consumption by the 2002 Clark County population, and then multiplying that figure by the appropriate emission factor in Tables 3-11 and 3-12. This process yielded the total wood burning activity by equipment type.

Emission factors for this source category were drawn from several sources: AP-42, EIIP, and from the documentation for the 1999 National Emission Inventory for Hazardous Air Pollutants. Table 3-11 summarizes the emission factors for criteria pollutants and their sources. Table 3-12 lists the emission factors for HAPs adopted from the 1999 NEI for HAPs.

Table 3-11. Residential wood combustion criteria pollutant emission factors.

		Stoves & Inserts				
	Fireplaces	**Uncontrolled**	**Phase I: Catalytic**	**Phase I: non-Catalytic**	**Phase II: Catalytic**	**Phase II: non-Catalytic**
Source for this equipment type:	**U.S. EPA, 1995**	**EIIP, 2001b**	**U.S. EPA, 1995**	**U.S. EPA, 1995**	**EIIP, 2001b**	**EIIP, 2001b**
NOx	2.6	2.8	2	2.8	2	2.8
SOx	0.4	0.4	0.4	0.4	0.4	0.4
PM_{10}	34.6	30.6	19.6	20	16.2	14.6
CO	252.6	230.8	104.4	230.8	107	140.8
VOC	229	53	15	12	15	12

Table 3-12. Residential wood combustion HAP emission factors.

Code	Pollutant	Fireplaces	Residential Heating: Catalytic Woodstoves - General	Residential Heating: Non Catalytic Woodstoves - General	Residential Heating: Woodstoves – Conventional
600	2,3,7,8-TCDD TEQ	2.00E-09	2.00E-09	2.00E-09	2.00E-09
57976	7,12-Dimethylbenz[a] Anthracene			1.62E-03	
83329	Acenaphthene		3.08E-03	4.04E-03	6.21E-03
208968	Acenaphthylene		3.49E-02	1.29E-02	1.32E-01
120127	Anthracene		4.10E-03	3.64E-03	8.69E-03
56553	Benz[a]Anthracene		1.23E-02		1.24E-02
71432	Benzene		1.46E+00		1.94E+00
203123	Benzo(g,h,i)Fluoranthene		3.08E-03	1.13E-02	
50328	Benzo[a]Pyrene		2.05E-03	2.42E-03	2.48E-03
205992	Benzo[b]Fluoranthene		2.05E-03	1.62E-03	3.73E-03
192972	Benzo[e]Pyrene		2.05E-03	8.08E-04	7.45E-03
191242	Benzo[g,h,i,]Perylene		1.03E-03	8.08E-03	2.48E-03
207089	Benzo[k]Fluoranthene		1.03E-03		1.24E-03
92524	Biphenyl			8.89E-03	
125	Cadmium & Compounds			2.00E-05	2.20E-05
218019	Chrysene		5.13E-03	4.04E-03	7.45E-03
53703	Dibenzo[a,h]Anthracene		1.03E-03	1.62E-03	
206440	Fluoranthene		6.16E-03	3.23E-03	1.24E-02
86737	Fluorene		7.18E-03	5.66E-03	1.49E-02
193395	Indeno[1,2,3-c,d]Pyrene		2.05E-03	8.08E-03	
198	Manganese & Compounds			1.40E-04	1.70E-04
78933	Methyl Ethyl Ketone		6.20E-02		2.90E-01
91203	Naphthalene		9.54E-02	5.82E-02	1.79E-01
226	Nickel & Compounds			2.00E-05	1.40E-05
95476	o-Xylene		1.86E-01		2.02E-01
198550	Perylene			8.08E-04	
85018	Phenanthrene		2.46E-02	4.77E-02	4.84E-02
129000	Pyrene		5.13E-03	3.23E-03	1.49E-02
108883	Toluene		5.20E-01		7.30E-01

With these emission factors and the county-specific activity developed for each stove type, producing the 2002 annual emissions was a matter of multiplying the activity for each equipment type by the corresponding emission factor for that equipment. However, given that the equipment types for which activity was developed (Table 3-10) do not exactly match up with the SCCs available (Table 3-11), in some cases the emissions from more than one equipment type were combined to fill one SCC. The correspondence of the equipment types listed in Tables 3-9 and 3-10 with the SCCs is shown in Table 3-13.

Table 3-13. Match of residential wood combustion SCC to equipment type.

SCC	Corresponding Equipment
2104008001	Fireplaces
2104008002[1]	Fireplace Insert, Uncontrolled
2104008003[2]	Fireplace Insert, Phase I, Non-Catalytic + Phase 2, Non-Catalytic
2104008004[3]	Fireplace Insert, Phase I, Catalytic + Phase 2, Catalytic
2104008030	Wood Stove, Phase 1, Catalytic + Phase 2, Catalytic
2104008051	Wood Stove, Uncontrolled
2104008052	Wood Stove, Phase 1, Non-catalytic + Phase 2, Non-catalytic

[1] Lumped into 2104008051
[2] Lumped into 2104008052
[3] Lumped into 2104008030

Seasonal Emissions

Summer and winter average day emissions were calculated through a two step process. First, emissions were allocated to each month based on the ratio of heating degree days occurring in the month to the total annual heating degree days. This ratio was based on data from the Western Regional Climate Center (WRCC, 2003). Second, the emissions for June through August were summed and divided by 92 (number of days in summer) and emissions for December, January and February were summed and divided by 90 (number of winter days) to yield summer average day emissions and winter average day emissions, respectively.

Given an average equipment age of twelve years, the assumption of equal annual equipment purchases and the federal regulation mandating emissions limits on wood stoves and fireplace inserts manufactured on/after July 1, 1988 (Federal Register, 1988), Table 3-14 shows the distribution of stoves/inserts in use in the year 2002. The assumption is that the median year of purchase is 1990 (2002 – 12 year average age).

Table 3-14. 2002 Distribution of stove ages and types.

Years During Which Equipment Type Purchased	Equipment Type	2002 Percentage of Total In-Place Stoves/Inserts
Pre 1990	Uncontrolled	50
1990 - 91	Phase I	4.2
1991 - 2002	Phase II	45.8
1984 - 2002	Total	100.0

Sample Calculations

$$E = EF_{voc,i} * F_i * C * D * P_{02} / 2000 \text{ lbs/ton}$$

where: E = Annual emission of VOCs (tons)
C = per-capita wood burned (cords/capita)
D = Density of a cord of wood (lbs/cord)
P_{02} = 2002 Clark County Population
F_i = The fraction of wood burned in equipment type i
$EF_{voc,i}$ = VOC emission factor for equipment type i

A sample calculation using this equation for estimating VOC for residential wood combustion in phase I, catalytic woodstoves inserts in Clark County is:

where: C = 0.027

P_{02} = 1,578,332

F_i = fraction of wood burned in phase I, catalytic inserts, 0.009

D = 0.94 tons/cord

$EF_{voc,i}$ = 15 lbs/ton

$E = EF_{voc,i} * F_i * C * D * P_{02}$ / 2000 lbs/ton

E = 15 * 0.009 * 0.027 * 0.94 * 1,578,332 / 2000 lbs/ton = 2.7 tons VOC

To calculate winter emissions the following formula was used:

$$E_{WD,VOC} = (E*HDD_J/HDD_A + E*HDD_F/HDD_A + E*HDD_D/HDD_A)/d$$

where: $E_{WD,VOC}$ = Winter average day emission of VOC

$HDD_{J,F,D}$ = Heating degree days in January (J), February (F) or December (D)

E = Total annual emissions

HDD_A = Annual heating degree days

d = Number of winter days, 91

FUEL COMBUSTION

Annual Emissions

State energy use data were collected from the Energy Information Administration (EIA) for years 1996 through 2001 (EIA, 2005a). Fuel consumption for 2002 was then estimated by using a linear regression. The fuel consumption data provided by the EIA is divided into five source categories and a number of fuels. The source categories and fuel types utilized in the area source inventory are shown in Table 3-15.

Table 3-15. Fuel combustion SCCs.

Source Categories	Fuels	SCC
Residential	Coal	2104002000
Residential	Natural Gas	2104006000
Residential	Liquid Petroleum Gas	2104007000
Residential	Distillate Oil	2104004000
Commercial/Institutional	Coal	2103002000
Commercial/Institutional	Natural Gas	2103006000
Commercial/Institutional	Liquid Petroleum Gas	2103007000
Commercial/Institutional	Distillate Oil	2103004000
Commercial/Institutional	Residual Oil	2103005000
Industrial	Coal	2102002000
Industrial	Natural Gas	2102006000
Industrial	Liquid Petroleum Gas	2102007000
Industrial	Distillate Oil	2102004000
Industrial	Residual Oil	2102005000

To apportion state level residential consumption to Clark County, 2000 Census data on the number of homes heating with each fuel type and the total annual heating-degree-days (HDD) for Clark County, Washoe County, and an average for all other counties were used. The number of homes in that county (or group of counties) heating with that fuel (HWF) was multiplied by the ratio of population in that county (or group of counties) in 2002 to the population in 2000 and the annual heating degree days for that county (or group of counties) (Clark County Comprehensive Planning, 2005 and WRCC, 2003). The resulting HDD*HWF were summed for a state total HDD*HWF. The fraction of fuel use to be apportioned to Clark County was the HDD*HWF for the county divided by the total HDD*HWF for the state. Multiplying that ratio by state level residential consumption of that fuel gives Clark County activity.

For industrial and commercial activity, the ratio used for apportioning was county level employment by NAICS to state level employment by NAICS. These figures were collected from 2001 *County Business Patterns* offered by the US Census Bureau (U.S. Census Bureau, 2005). The NAICS codes used are shown in Table 3-16.

Table 3-16. NAICS used to spatially allocate fuel consumption.

Commercial	Industrial
42,44,51,52,53,54,55,56,61,62,71,72,81,95,99	22,31

Clark County DAQEM staff indicated no sources of coal combustion within Clark County, therefore, Nevada statewide coal use data was not allocated to Clark County, and coal combustion emissions were set to zero.

Emissions of criteria pollutants were then determined by applying emission factors from AP-42 to the activity data. These emission factors are detailed in Table 3-17.

Table 3-17. AP-42 fuel consumption emission factors for criteria pollutants.

Source	Fuel	EF Units	Pollutant	AP-42 Emission Factor
Residential	Coal	(lb/ton)	VOC	10.0
			CO	275
			NOx	9.1
			SOx	93.0
			PM_{10}	6.2
			$PM_{2.5}$	6.2
Residential	Natural Gas	(lb/10^6 scf)	VOC	5.5
			CO	40
			NOx	94
			SOx	0.6
			PM_{10}	7.6
			$PM_{2.5}$	7.6
Residential	Liquid Petroleum Gas	(lb/10^3 gal)	VOC	0.3
			CO	1.9
			NOx	14

Source	Fuel	EF Units	Pollutant	AP-42 Emission Factor
			SOx	neg
			PM_{10}	0.4
			$PM_{2.5}$	0.4
Residential	Distillate Oil	(lb/10^3 gal)	VOC	0.713
			CO	5
			NOx	18
			SOx	85.2
			PM_{10}	0.4
			$PM_{2.5}$	0.4
Commercial/Institutional	Coal	(lb/ton)	VOC	1.3
			CO	11
			NOx	9.5
			SOx	93.0
			PM_{10}	6.2
			$PM_{2.5}$	6.2
Commercial/Institutional	Natural Gas	(lb/10^6 scf)	VOC	5.5
			CO	84
			NOx	100
			SOx	0.6
			PM_{10}	7.6
			$PM_{2.5}$	7.6
Commercial/Institutional	Liquid Petroleum Gas	(lb/10^3 gal)	VOC	0.3
			CO	1.9
			NOx	14
			SOx	neg
			PM_{10}	0.4
			$PM_{2.5}$	0.4
Commercial/Institutional	Distillate Oil	(lb/10^3 gal)	VOC	0.340
			CO	5
			NOx	20
			SOx	85.2
			PM_{10}	2.0
			$PM_{2.5}$	2.0
Commercial/Institutional	Residual Oil	(lb/10^3 gal)	VOC	1.130
			CO	5
			NOx	55
			SOx	353.3
			PM_{10}	13.1
			$PM_{2.5}$	5.8

Source	Fuel	EF Units	Pollutant	AP-42 Emission Factor
Industrial	Coal	(lb/ton)	VOC	0.05
			CO	6
			NOx	7.5
			SOx	114.0
			PM_{10}	6.2
			$PM_{2.5}$	6.2
Industrial	Natural Gas	(lb/10^6 scf)	VOC	5.5
			CO	84
			NOx	280
			SOx	0.6
			PM_{10}	7.6
			$PM_{2.5}$	7.6
Industrial	Liquid Petroleum Gas	(lb/10^3 gal)	VOC	0.3
			CO	3.2
			NOx	19
			SOx	neg
			PM10	0.6
			$PM_{2.5}$	0.6
Industrial	Distillate Oil	(lb/10^3 gal)	VOC	0.200
			CO	5
			NOx	24
			SOx	94.2
			PM_{10}	2.0
			$PM_{2.5}$	2.0
Industrial	Residual Oil	(lb/10^3 gal)	VOC	0.280
			CO	5
			NOx	47
			SOx	353.3
			PM_{10}	10.0
			$PM_{2.5}$	10.0

Annual emissions of hazardous air pollutants were calculated using the same activity data as used for criteria pollutants. Emission factors were drawn from AP-42 and from the documentation for the 1999 NEI of HAPs (U.S. EPA, 1995 and U.S. EPA, 2003b). There are several restrictions/assumptions governing the use of these emission factors which are detailed below by associated fuel type.

Propane LPG: No emission factors have been developed for propane LPG. Based on a recommendation in the AP-42 background documentation, emissions were generated using emission factors for natural gas to obtain an order of magnitude estimate (U.S. EPA, 1995).

In addition to the above assumptions, it was necessary to use one set of emission factors to estimate emissions for all fuels from both institutional/commercial and residential combustion. The equipment used in these two different categories probably results in different emissions, however, until more emission factors are developed this was judged the best available alternative. Similarly, emission factors for the industrial combustion of distillate oil were not available, so the emission factors for commercial combustion were used.

Point Source Reconciliation

The area source fuel combustion emissions estimate used the estimated total fuel consumption of Clark County as its fundamental measure of activity. In fact, much of that fuel was consumed by industrial and commercial facilities that are represented in the point source emission inventory. Therefore, to eliminate double counting of emissions from fuel combustion, it was necessary to subtract fuel consumed by these industrial facilities and the emissions of commercial point source facilities from the area source emissions calculation.

To determine the extent of double counting with the point source inventory, that inventory was queried to extract the point source facilities with combustion processes. The resulting list of facilities was further reduced by eliminating electric generation facilities and facilities that combusted only a byproduct (e.g. a flare controlling VOC emissions) rather than a purchased fuel. These steps were taken to account for the fact that the area source emissions calculations did not include fuel used by electric generation facilities or such process byproducts. For the facilities that remained, the DAQEM was able to provide fuel consumption data for nearly all of the industrial sources. Using that data, the fuel consumed by those industrial point sources was extracted from the area source fuel combustion emissions calculation. The industrial facilities for which fuel consumption was determined and reconciled are listed in Table 3-18 below.

Table 3-18. Industrial point sources reconciled with area source fuel combustion.

Facility ID	Facility Name
0004	BPB Gypsum Blue Diamond
0011	PABCO Building Products AND Sandia
0019	TIMET (Titanium Metals)
0138	J R Simplot Company
0013	Kinder Morgan CalNev Pipe Line
0593	Georgia Pacific
0395	Republic Dumpco
0003	Chemical Lime AND Granite Construction Company
0468	Kern River - Goodsprings
0012	Wells Cargo, Inc.

A significant number of the point source facilities with fuel combustion processes were hotels and casinos. The DAQEM was not able to provide fuel consumption data for those commercial facilities. In consultation with the DAQEM, it was decided to extract fuel combustion occurring at hotels and casinos from the area source inventory by assuming that all NOx emissions at those facilities were due to natural gas combustion. This assumption is based on the observation that natural gas boilers appeared to be the most significant fuel combustion process in these facilities. To extract fuel combustion at hotels and casinos, the total NOx emissions were converted to an estimate of the natural gas consumed using the emission factor for commercial/institutional boilers. The natural gas estimated to be consumed by hotels and casinos was then subtracted from the area source fuel combustion emissions calculations.

The result of this point and area fuel combustion reconciliation may be a conservative estimate of emissions from fuel combustion, for two reasons. First, DAQEM was not able to provide fuel consumption for Nellis Air Force Base and Royal Cement. Thus, fuel combustion at those facilities may be double counted. Second, some hotels and casinos may use low NOx boilers, rather than the conventional, uncontrolled boiler type that was assumed in order to back out fuel combustion. If that were the case, then the quantity of fuel that should be subtracted from the area source fuel combustion calculations may have been underestimated.

Seasonal Emissions

Calculation of the summer/winter average day emissions were performed in two ways. For residential consumption, activity occurs seven days per week. The total number of heating degree days occurring during the summer/winter months were obtained and divided by the total number of HDD in the year. This ratio was multiplied by the total annual emission and then divided by the total number of summer/winter days (92 and 91 respectively).

The allocation for commercial/institutional and industrial combustion was based on standard EPA temporal allocation profiles, specified by SCC (U.S. EPA, 2002d); these profiles are listed in Table 3-19. From these profiles, the percentage of activity occurring during the summer and winter was calculated. This factor was then multiplied by the total annual emissions and then divided by the total number of days in the summer/winter (92 and 90, respectively).

Table 3-19. Seasonal and weekly allocation profiles for fuel consumption.

SCC			Monthly Profile #	Weekly Profile #
2102001000	Industrial	All fuels	262	8
2103007000	Commercial/Institutional	Liquefied Petroleum Gas (LPG) & Kerosene	262	8
2103001000	Commercial/Institutional	All other fuels	469	8

Sample Calculations

Emissions from Industrial Use of Distillate Oil (SCC2102004000)

$E_{NO} = CE / SE * EF_{NO} * SF / 2000$

where: E_{NO} = Annual emission of NOx (tons/year)
SE = 2002 estimated statewide employment in SIC 22 and 31
CE = 2002 estimated Clark County employment in SIC 22 and 31
SF = 2002 statewide industrial use of distillate oil (10^3 gal)

EF_{NO} = NOx emission factor for industrial combustion of distillate oil ($lbs/10^3$ gal)

A sample calculation using this equation for estimating NOx for industrial combustion of distillate oil:

where: SE = 45,160 employees
CE = 21,595 employees
SF = 87,780 1000 gal
EF_{NO} = 24 lb /1000 gal

$E_{NO} = CE / SE * EF_{NO} * SF / 2000$
$E_{NO} = 21{,}595 / 45{,}160 * 24 * 87{,}780 / 2000 = 504$ tons

ARCHITECTURAL SURFACE COATING

Annual Emissions

County usage of architectural surface coatings was estimated based on a national per-capita use factor. This factor was developed by dividing the 2002 national usage of surface coatings (U.S. Census Bureau, 2003) by the estimated 2002 national population (U.S. Census Bureau, 2005). This allowed for the generation of the usage factors listed in Table 3-20.

Table 3-20. Per-capita architectural surface coating use factors.

Solvent-based coating	0.444 gal/person-yr
Water-based coating	2.047 gal/person-yr

Multiplying these usage factors by the estimated 2002 Clark County populations gave the total county usage of solvent-based and water-based coatings. Emissions for each coating type were calculated as the product of usage and the EIIP emission factors listed in Table 3-21. The resulting emissions were then decreased by 20% to obtain the final VOC emissions. This reduction accounts for a national VOC rule promulgated after the development of the emission factors, for which the estimated impact on emissions was a reduction of 20% (Federal Register, 1998b).

Table 3-21. Architectural surface coating VOC emission factors.

VOC Emission Factors	lb VOC/gal
Solvent-based coating	3.87
Water-based coating	0.74

(EIIP, 1995)

Hazardous air pollutant emissions were then calculated based on the speciation of the VOC emissions. The EIIP document provides one speciation profile for VOC emissions from water-based coatings and one for emissions from solvent-based coatings shown in Table 3-22 (EIIP, 1995).

Table 3-22. Architectural surface coating HAP speciation profile.

		Weight Fraction of VOC
Water-Based Coatings		
112345	Diethylene Glycol Monobutyl Ether	0.007
71432	Benzene	0.003
75003	Ethyl chloride	0.006
107211	Ethylene glycol	0.005
74873	Methyl chloride	0.005
75092	Methylene chloride	0.055
Solvent-Based Coatings		
68122	N,N-Dimethylformamide	0.005
100414	Ethyl Benzene	0.043
107211	Ethylene glycol	0.006
1330207	Xylenes (Mixture of o, m, and p Isomers)	0.026
67561	methanol	0.039
78933	Methyl ethyl ketone	0.056
108101	Methyl isobutyl ketone	0.006
108883	Toluene	0.052

Seasonal Emissions

Surface coating is not practicable at temperatures below 50 degrees (EIIP, 1995). Monthly average temperatures in Clark County are in excess of 50 degrees year-round as shown in Table 3-23. Therefore, it was assumed that emissions will occur uniformly year-round in Clark County. Activity occurs seven days per week according to EIIP documentation (EIIP, 1995).

Table 3-23. Temperature data used to determine architectural surface coating season.

	Mean Number of Days with Max >= 50	Mean Daily Max
Jan	31	57.0
Feb	28	62.5
Mar	31	69.4
Apr	30	78.2
May	31	88.3
Jun	30	98.5
Jul	31	104.4
Aug	31	102.1
Sep	30	94.6
Oct	31	81.4
Nov	30	66.3
Dec	31	57.4

(N.O.A.A., 2004)

Sample Calculations

E_{VOC} = *(P * PFW * EFW + P * PFS * EFS) * ([1 - 0.2]/1)*
E_{HAP} = *(PWW * P* PFW * EFW + PWS * PFS * EFS) * ([1 - 0.2]/1)*

where: E_{VOC} = VOC emission (tons)
P = Clark County population
PFW = Per capita use factor for water-based coatings (gal/person-year)
PFS = Per capita use factor for solvent-based coatings (gal/person-year)
EFW = VOC emission factor for water-based coatings (lb/gal)
EFS = VOC emission factor for solvent-based coatings (lb/gal)
E_{HAP} = County HAP emissions (tons)
PWW = Percent weight of HAP in VOC emission from water-based coating
PWS = Percent weight of HAP in VOC emission from solvent-based coating

A sample calculation using this equation for estimating VOC for architectural surface coating is:

where: P =1,578,332
PFW = 2.047 gal/person-yr
PFS = 0.444 gal/person-yr
EFW = 0.74 lb VOC/gal
EFS = 3.87 lb VOC/gal
PWW = 0.005 Ethylene Glycol
PWS = 0.006 Ethylene Glycol

E_{VOC} = (P * PFW * EFW + P * PFS * EFS) * ([1 - 0.2]/1)
E_{VOC} = (1,578,332 * 2.047 * 0.74 + 1,578,332 * 0.444 * 3.87) * ([1 - 0.2]/1) / 2000 lb/ton
E_{VOC} = 2,040 tons

E_{HAP} = (PWW * P* PFW * EFW + PWS * P * PFS * EFS) * ([1 - 0.2]/1)
E_{HAP} = (0.005 * 1,578,332 * 2.047 * 0.74 + 0.006 * 1,578,332 * 0.444 * 3.87) * ([1 - 0.2]/1) / 2000 lb/ton
E_{HAP} = 11.3 tons Ethylene Glycol

DEGREASING

Annual Emissions

In order to achieve the most detailed characterization that is possible with the resources available, emissions for solvent degreasing were estimated using two different approaches. Each of these approaches covered a different type of solvent utilization activity. Both methods used were developed by the EIIP and use employment as activity and per-employee emission factors to determine emissions, however they differ significantly enough so as to warrant separate discussions. Table 3-24 shows which SCCs were covered by each method.

Table 3-24. Degreasing SCCs listed by the methodology used.

Solvent Cleaning Equipment	Solvent Cleanup Activities
2415360000	2415035000
2415345000	2415020000
2415230000	2415005000
2415245000	2415030000
	2415025000
	2415040000
	2415045000

EIIP Method: Solvent Cleaning Equipment

The activity used to calculate degreasing emissions from solvent cleaning equipment was 2002 Clark County employment. Employment data is available from County Business Patterns and that data is categorized by NAICS. NAICS categories were identified as corresponding to the SIC categories in question (U.S. Census Bureau, 1998). County employment data for 2002 were collected for these NAICS categories. The product of Clark County employment and a per-employee emission factor from the EIIP document was then used to calculate emissions. The emission factor and the corresponding employment categories are shown in Table 3-25.

Table 3-25. EIIP per employee emission factor for solvent cleaning equipment.

SCC	Description	Corresponding SIC	lbs VOC/employee-yr[1]
2415360000	Cold Cleaning - Automobile Repair	417, 423, 551,552, 554-556,753	264
2415345000	Cold Cleaning - Manufacturing	25, 33-39	23
2415230000	Vapor and In-Line Cleaning - Electronics and Electrical	36	28
2415245000	Vapor and In-Line Cleaning - Other	25, 33-39, 417,423, 551, 552,554-556, 753	10

[1] Emission factors were adjusted downward to account for PERC emissions, not to be included in an ozone VOC inventory. (EIIP, 1997b)

Hazardous air pollutant emissions were calculated based on a generic HAP speciation profile for degreasing solvents presented in EPA's SPECIATE database (see Table 3-26). This profile was applied to the solvent cleaning equipment VOC emissions.

Table 3-26. Hazardous air pollutant speciation profile for degreasing solvents from EPA's SPECIATE database.

Code	Pollutant	Percent of VOC
110805	Cellosolve Solvent	0.41%
71556	Methyl Chloroform (TCA)	23.67%
75092	Methylene Chloride	4.28%
127184	Tetrachloroethylene	2.31%
79016	Trichloroethylene	8.28%

(U.S. EPA, 2002e)

As part of Title VI of the Clean Air Act Amendments, the production of Methyl Chloroform (TCA) for use in the United States was phased out in 1995. Presumably, significant use continued after that phase out as remaining stocks were consumed (EIIP, 1997b). Pechan estimated that TCA use would continue in diminishing quantities for between two and ten years after the phase out (ARB, 1996). For this inventory it is assumed that seven years after the phase out, use of TCA is negligible and therefore emissions have not been calculated for that HAP.

Sample Calculations

$CE = EF * EMP / 2000\ lbs/ton$
$HE = CE / (1-P_{PERC}) * PH/100$

where: CE = emission of VOC from Cold Cleaning, Automobile Repair (ton)
EMP = Clark County employment in SIC 417, 423, 551, 552, 554-556, 753
EF = EIIP per-employee emission factor (lb/employee-year)
HE = County emission of HAP (tons)
P_{PERC} = Percent of VOC emissions as perc
PH = HAP percent mass of VOC

A sample calculation using this equation for estimating VOC for cold-cleaning, automobile repair:

where: EF = 264 lb VOC / employee-year
EMP = 16,606 employees
PH = 4.28 percent for Methylene Chloride
P_{PERC} = 2.31%

CE = EF * EMP
CE = 264 * 16,606 / 2000 lbs/ton = 2190 tons VOC

$HE = CE / (1-P_{PERC}) * PH/100$
HE = 2190 / (1-2.31/100) * 4.28/100 = 96 tons Methylene Chloride

EIIP Method: Solvent Cleanup

The EIIP Method for estimating emissions from solvent cleanup activities was developed from information collected for the Industrial Cleaning Solvents ACT (EIIP, 1997a). The Industrial Cleaning Solvents ACT provides estimates of solvent amounts used at the national level for cleanup activities for 15 industries. These estimates were drawn from references that were prepared as early as 1979 and as recently as 1993. For 9 of the 15 industries, the ACT provides estimates of national VOC emissions from cleanup and for the other 6 industries solvent volume-use estimates are provided. Emissions were estimated for 8 of 9 industries for which ACT provided national VOC emissions estimates and 2 of 6 for which ACT provided national VOC usage emissions. For the two industries for which VOC emission estimates were not available, 100% volatilization was conservatively assumed for all VOC used in solvent cleanup activities. Emission factors were calculated for each industry by taking the midpoint of the range of the year VOC emissions or solvent use and dividing this number by the 1990 U.S. employment (U.S.

Census, 1996) for the industry. Table 3-27 shows industries for which emissions in Clark County were estimated, SIC codes, corresponding SCC codes, and emission factors. Of the five industries dropped from consideration for emissions from solvent cleanup, packaging and was dropped because emissions from the packaging industry are most commonly associated with point sources; lithographic printing, retrograve printing, and autobody refinishing were included in other area source categories; and there was a lack of information regarding employment for FRP boats.

Table 3-27. Industries for which solvent cleanup activities were estimated.

SCC	Industry	SIC	Emission Factors (tons/year/employee)
2415035000	Automotive-Manufacturing	3711	0.139
	Automotive-Trucks and Buses	3713	0.394
	Automotive-Parts/Accessories	3714	5.57×10^{-3}
2415020000	Automotive-Stamping	3465	2.89×10^{-3}
2415005000	Furniture	2500	8.99×10^{-2}
2415030000	Electrical Equipment	3600	1.51×10^{-3}
2415025000	Magnetic Tape	3577	1.37×10^{-2}
2415040000	Photographic Supplies	3680	5.55×10^{-3}
2415045000	Adhesives	2891	8.33×10^{-3}
2415045000	Plastics	3000	8.74×10^{-5}

Emission estimates were made by multiplying the per-employee emission factor by the number of employees in Clark County employed in that industry in 2002. Employment data is available from County Business Patterns and that data is categorized by NAICS. NAICS categories were identified as corresponding to the SIC categories in question (U.S. Census Bureau, 1998). County employment data for 2002 were collected for these NAICS categories.

As in solvent cleaning equipment emissions, hazardous air pollutant emissions for solvent cleanup activities were calculated based on a generic HAP speciation profile for degreasing solvents presented in EPA's SPECIATE database (see Table 3-26).

Sample Calculations

$EE = EF * EMP$
$EH = CE/ (1-P_{PERC}) * PH/100$

where: CE = emission of VOC from electrical equipment, solvent cleanup (tons)
EMP = Clark County employment in SIC 3600
EF = EIIP per-employee emission factor (lb/employee-year)
HE = County emission of HAP (tons)
P_{PERC} = Percent of VOC emissions as percPH = HAP percent mass of VOC

A sample calculation using this equation for estimating VOC for electrical equipment, solvent cleanup is as follows:

where: EMP = 2,765 employees
EF = 1.51×10^{-3} tons/year-employee
P_{PERC} = 2.31%
PH = 4.28% for Methylene Chloride

EE = EF * EMP
EE = 1.51×10^{-3} * 2,765 = 4.2 tons/year

HE = CE / (1-P_{PERC}) * PH/100
HE = 4.2 / (1-2.31/100) * 4.28/100 = 0.18 tons Methylene Chloride

CUTBACK ASPHALT

Annual Emissions

The Nevada Department of Transportation provided 2002 cutback asphalt use for Clark County. According to personnel of Las Vegas Paving, NDOT use accounts for most cutback asphalt use in Clark County, while significantly smaller quantities are used at McCarran Airport (Breault, 2005). NDOT reported the use of 289 tons of medium cure cutback asphalt product MC-70 in 2002.

With no data available on the diluent content, a midpoint value for medium cure asphalt was used (35%), as recommended by EIIP. The EIIP document also provides an emission factor of 20% VOC by weight of cutback asphalt and a HAP speciation profile (Table 3-28) to apply to VOC emissions (EIIP, 2001c).

Table 3-28. Percent weight of HAPs in VOC emissions from cutback asphalt.

HAP Percent Weight of VOC		
100414	Ethyl Benzene	2.3%
108883	Toluene	6.4%
1330207	Xylenes (Mixture of o, m, and p Isomers)	12.2%

(EIIP, 2001c)

Seasonal Emissions

Nevada department of transportation was contacted to establish the seasonality of cutback asphalt paving. Paving occurs year-round (Connors, 2004). The EIIP document states that due to the nature of cutback asphalt emissions, they should be assumed to occur seven days per week. Thus the average day summer and winter emissions were calculated as the annual emissions divided by 365 days.

Sample Calculations

*CE = P/100 * W*
*HE = PW/100 * CE*

where: CE = Clark County emission of VOC from cutback asphalt use (tons)
W = Weight of cutback asphalt used in the county (tons)
P = Percent weight of cutback asphalt emitted as VOC
HE = Clark County emission of HAP (tons)
PW = HAP percent weight of VOC

A sample calculation using this equation for estimating VOC for architectural surface coating in Clark County is:

where: P = 20%
W = 289 tons
PW = 6.4 for Toluene

CE = P/100 * W
CE = 20/100 * 289 tons = 57.8 tons VOC

HE = PW/100 * CE
HE = 6.4/100 * 57.8 tons = 3.7 tons Toluene

AGRICULTURAL PESTICIDE APPLICATION

Annual Emissions

To develop a picture of what pesticides were used in the Clark in 2002 and in what quantities, pesticide application rates for Nevada crops were collected from a 2000 report produced by the National Center for Food and Agricultural Policy (NCFAP, 2000). The fraction of acres of each crop that the pesticide was applied to and the average quantity applied per acre of that crop were multiplied by the 2002 harvested acreage of the crop in Clark County (NASS, 2004).

The pesticides selected for this focused effort were those that according to the NCFAP data represented 85% of the total weight of pesticide use in 1997. However, ethyl parathion, which accounted for 5% of the total weight of pesticide use in 1997, was phased out from December 31, 2001 and its last legal application was on October 31, 2003. Therefore, it was assumed that ethyl parathion was not used in appreciable quantities in 2002 and was not included in emissions estimations.

The emission factors for VOC resulting from the emission of these active ingredients are presented in the EIIP document based on the vapor pressure of the ingredient. Some of the vapor pressures for the active ingredients in Table 3-29 were listed in the same EIIP document and the remaining were collected from a variety of online chemical information databases. The emission factors used are shown in Table 3-30.

Table 3-29. Formulation type and application method for common pesticides.

Pesticide	Method of Application	Formulation Type
2,4-DB	Surface Application	Aqueous Concentrate
CARBARYL	Surface Application	Emulsifiable Concentrate
CARBOFURAN	Surface Application	Emulsifiable Concentrate
CHLORPYRIFOS	Surface Application	Emulsifiable Concentrate

Pesticide	Method of Application	Formulation Type
DIMETHOATE	Surface Application	Emulsifiable Concentrate
DIURON	Surface Application	Aqueous Concentrate
HEXAZINONE	Surface Application	Aqueous Concentrate
IMAZETHAPYR	Surface Application	Aqueous Concentrate
METRIBUZIN	Surface Application	Aqueous Concentrate
PERMETHRIN	Surface Application	Emulsifiable Concentrate
SETHOXYDIM	Surface Application	Emulsifiable Concentrate

(Franklin, 2004 & Weldert, 2004)

Table 3-30. Pesticide VOC emission factors by application method and vapor pressure.

Method of Application	Vapor Pressure Range (as mmHg @ 20-25 C)	VOC (lb/ton AI)
surface application	VP < 0.0001	700
surface application	VP > 0.0001	1160
soil incorporation	VP < 0.000001	5.4
soil incorporation	0.000001 < VP < 0.0001	42
soil incorporation	VP > 0.0001	104

(EIIP, 2001d)

The quantity of active ingredient applied was multiplied by the appropriate emission factor (matching method of application and vapor pressure range) from Table 3-30 to estimate VOC emissions resulting from use of that pesticide. Summing these emissions over all pesticides resulted in the VOC emissions from the active ingredients.

The emissions from inert ingredients were determined by first finding the percent weight of inert ingredients in the pesticide formulation. The MSDS for various brands of these pesticides were consulted to determine that percent (CDMS, 2004). The tons of inert ingredients applied were determined by multiplying the ratio of percent weight of inert ingredients to percent weight of active ingredients by the tons of active ingredients applied. The VOC fraction of the inert ingredients was based on the formulation type of the pesticide (see Table 3-29). The EIIP document provides VOC fractions based on formulation type. The relevant VOC fractions are shown in Table 3-31. The product of the tons of inert ingredients applied and the VOC content from Table 3-31 is the VOC emission resulting from the inert ingredients. Again, summing these for all pesticides yielded the VOC emissions from the inert ingredients. Adding that figure to the corresponding figure for active ingredients determined the total VOC emissions from 80% of pesticide use. (Remember that the pesticides representing 80%, 85% minus 5% due to discontinuation of ethyl parathion, of total use were focused on to determine pesticide content.) Based on the assumption that the VOC content of the top 80% of pesticides was representative of the VOC content of the remaining 20%, the total VOC emission was divided by 0.80 to account for the 20% of pesticide weight that was not researched.

Table 3-31. VOC content of inert ingredients by pesticide formulation.

Formulation Type	VOC Content of Inert
Emulsifiable concentrate	56%
Aqueous Concentrate	21%
Granule/flake	25%

(EIIP, 2001d)

Only one of the active ingredients, 2,4-DB was identified as a hazardous air pollutant. The MSDS for various brands of these pesticides were consulted to determine if air toxics were included in the inert portion of the product formulation. Only diuron, permethrin, and sethoxydim formulations were found to contain appreciable quantities of ethylene glycol, xylene and ethyl benzene, and napthalene, respectively. Thus, HAP emissions were calculated for 2,4-DB, ethylene glycol, xylene, ethyl benzene, and napthalene.

For 2,4-DB, the emission of HAPs was calculated as the sum of the active ingredient emissions for 2,4-DB pesticides (already calculated for VOCs). For ethylene glycol, xylene, ethyl benzene, and napthalene, it was assumed that the total weight of those compounds contained in the formulation would be emitted to the air. Therefore the emissions were calculated as the product of the total weight of the pesticide applied (weight of active ingredient applied + weight of inert ingredient applied) and the percent weight of the HAP compound. Those percent weights are presented in Table 3-32. As was done for VOC, the resulting HAP emissions were scaled up by dividing by 0.80 to account for the 20% of pesticide weight that was not researched.

Table 3-32. Percent weight of HAPs in pesticides.

Pesticide	HAP in Inert Ingredients	% Weight of HAP
DIURON	Ethylene Glycol	3%
PERMETHRIN	Xylene	10%
	Ethylbenzene	2%
SETHOXYDIM	Napthalene	7%

(CDMS, 2004)

Seasonal Emissions

Pesticide emissions were assumed to occur only in summer months.

Sample Calculations

$$E = ((AEF * A * AF * Q / 2000 / 2000 + (A * AF * Q / 2000\ ) / (PA/100) * (PI/100) * FI) / 0.80$$

where: E = Total county VOC emission for this pesticide-crop combination
A = Acreage of crop harvested
AF = Acreage fraction to which pesticide is applied
Q = Quantity (lb active ingredient / acre) of pesticide applied
AT = Tons of active ingredient (AI) applied

AEF = AI emission factor dependent upon VP and AM
PA = Percent of pesticide that is AI
PI = Percent of pesticide that is inert ingredient
FI = Fraction of the inert ingredient that is VOC (dependent upon AM)
VP = Vapor pressure of active ingredient
AM = Application method
AEF = Select from Table 3-30 based on AM and VP

A sample calculation using this equation for estimating VOC for the pesticide 2,4-D applied to alfalfa:

where: A = 6,000 acres
AF = 0.01
Q = 1.06 lb AI/acre
AT = 0.0318 tons
AEF = 700 lb VOC/AI ton
PA = 26
PI = 74
FI = 0.21
VP = $8.0\text{x}10^{-6}$
AM = Surface application

E = ((AEF * A * AF * Q / 2000 / 2000 + (A * AF * Q / 2000) / (PA/100) * (PI/100) * FI) / 0.85
E = (700 * 6,000 * 0.01 * 1.06 / 2000 / 2000 + (6,000 * 0.01 * 1.06 / 2000) / (26/100) * (74/100) * 0.21) / 0.80 = 0.0377 tons VOC

TRAFFIC MARKINGS

Annual Emissions

To estimate emissions from traffic markings, year 2002 coating usage data were obtained from the Nevada Department of Transportation (NDOT) (Connors, 2005), City of Las Vegas Public Works Department (Gartland, 2005), and Clark County Public Works Department (Cederberg, 2005). NDOT provided the linear and area totals of the amount of surface marked by water-based and solvent-based coatings. The City of Las Vegas provided volume-use estimates for water-based and solvent-based coatings, and Clark County provided an aerial estimate of water-based and solvent based coating application. For the City of North Las Vegas and the City of Henderson, no coating data was available. The activity data for these two cities was estimated as the product of the quantity applied in Las Vegas and the ratio of City of Henderson 2002 population or City of North Las Vegas 2002 population to City of Las Vegas 2002 population. Table 3-33 summarizes activity data used to estimate emissions from traffic markings.

Table 3-33. 2002 Traffic Marking Activity Data.

Source	Water-based	Solvent Based	Units
Nevada DOT	220	325	lane-miles painted
Clark County Public Works	27	68	lane-miles painted
City of Las Vegas	4775	2160	gallons
City of North Las Vegas[1]	1262	571	gallons
City of Henderson[1]	1951	883	gallons

[1] Estimates are based on City of Las Vegas activity data and population.

The EIIP document provides VOC emission factors for volume-use estimates, and lane-miles marked estimates as shown in Table 3-34. The activity data for each source was multiplied by the appropriate emission factor to determine VOC emissions resulting from traffic marking by each source. VOC emissions from each source were summed to obtain Clark County Emissions.

Table 3-34. Traffic marking VOC Emission Factors.

Date Type	Water-based	Solvent Based	Units
Volume-use	13	52	lb/lane-miles painted
Lane-miles marked	0.72	3.64	lb/gal

(EIIP, 1997c)

HAP emissions were determined using the same basic process. Consumption estimates were multiplied by the EIIP reported volume percent and density of each HAP in the average coating (shown in Table 3-35) to estimate the emission of that HAP. Where only lane-miles marked data was available, the default factor of 16 gal/lane mile (EIIP, 1997c) was multiplied by lane-miles marked to obtain volume-use estimates and HAP emissions were estimated as described above. The HAP speciation profile is based on a sales-weighted average traffic paint from a 1991 survey. The use of this profile may result in some inaccuracy in the representation of Clark County emissions, however, no alternative profile offering greater accuracy was identified.

Table 3-35. HAP speciation profile for traffic markings.

HAP	Volume %	Density (lb/gal)
Carbon tetrachloride	0.009	12.19
Cumene	0.002	7.19
Ethylbenzene	0.009	7.24
Ethylene glycol	0.086	9.31
Glycol ethers	0.04	7.01
Methyl ethyl ketone	1.514	6.89
Methyl isobutyl ketone	0.002	6.71
Methyl methacrylate	0.044	7.84
Naphthalene	0.002	9.55
Propylene oxide	0.115	6.93
Styrene	0.277	7.55
Toluene	6.914	7.23
Xylenes (mixed isomers)	0.499	7.18

(EIIP, 1997c)

Seasonal Emissions

NDOT, Clark County and City of Las Vegas personnel indicated that traffic markings are applied year-round. Application is assumed to occur five days per week as indicated in the EIIP document (EIIP, 1997c).

Sample Calculations

$CE_{VOL} = EF_{VOL} * A_{VOL} / 2000 \text{ lb/ton}$
$CE_{LM} = EF_{LM} * A_{LM} / 2000 \text{ lb/ton}$
$HE_{VOL} = HF * A_{VOL} / 2000 \text{ lb/ton}$
$HE_{LM} = HF * A_{LM} * 16 \text{ gal / lane mi} / 2000 \text{ lb/ton}$

where: CE_{VOL} = County emission of VOC from traffic markings where activity data available as volume-use estimates (tons)
CE_{LM} = County emission of VOC from traffic markings where activity data available as lane-miles marked estimates (tons)
EF_{VOL} = Traffic-marking volume-use emission factor (lb/gal)
EF_{LM} = Traffic marking lane-miles emission factor (lb/lane-mi)
A_{VOL} = volume-use estimate (gal)
A_{LM} = lane-miles marked estimate (mi)
HE = County HAP emission
HF = HAP emission factor

A sample calculation using these equations for estimating VOCs from the application of water-based traffic markings for the City of Las Vegas is:

where: EF_{VOL} = 0.72 lb/gal
A_{VOL} = 4775 (gal)
HF = 0.0011 lbs Carbon Tetrachloride / gal marking

$CE_{VOL} = EF_{VOL} * A_{VOL} / 2000 \text{ lb/ton}$
$CE_{VOL} = 0.72 * 4775 / 2000 \text{ lbs/ton}$
$CE_{VOL} = 1.72 \text{ tons VOC}$

$HE_{VOL} = HF * A_{VOL} / 2000 \text{ lb/ton}$

$HE = 0.0011 * 4775 / 2000 \text{ lb/ton}$
$HE = 2.6 \times 10^{-3}$ tons Carbon Tetrachloride

A sample calculation using these equations for estimating VOCs and the HAP carbon tetrachloride from the application of water-based traffic markings for Nevada DOT is:

EF_{LM} = 13 lb/lane-mi
A_{LM} = 220 lane-mi
HF = 0.0011 lbs Carbon Tetrachloride / gal marking

$CE_{LM} = EF_{LM} * A_{LM}$ / 2000 lb/ton
CE_{LM} = 13 * 220 / 2000 lbs/ton
CE_{LM} = 1.43 tons VOC

$HE_{LM} = HF * A_{LM}$ * 16 gal/lane-mi / 2000 lb/ton
HE_{LM} = 0.0011 lbs/gal * 220 * 16 gal/lane-mi / 2000 lb/ton
$HE_{LM} = 1.94x10^{-3}$ tons Carbon Tetrachloride

LANDFILLS

Emissions from landfills were calculated using the equations from AP-42 (U.S. EPA, 1995). The minimum information required to use those equations is:

- Year landfill first accepted waste
- Year landfill stopped accepting waste
- Annual waste acceptance (Mg/year)

The above data requirements for landfills in Clark County were unavailable. So, emission estimates were derived based on annual acceptance rates and the conservative assumption of no closed landfills. Both of the largest landfills in Clark County, Sunrise and APEX, have flares for emissions control (Tidwell, 2005), so flare controls were applied to VOC and HAP emissions.

The estimates of waste acceptance were based on per-capita generation of MSW (Nevada DEP, 2004). Estimated 1978-2002 population (Nevada State Demographer, 2005) was used with the Clark County average per-capita waste generation, Table 3-36, to estimate the annual generation of MSW for Clark County from 1978 to 2002. For years in which per-capita generation of MSW is not available, the average of the years available was used. It was further assumed that the average recycling rate applied to years 1995 to 2002 and prior to 1995 the recycling rate was conservatively estimated to be zero.

Table 3-36. Clark County estimated waste generation rates.

Year	MSW Generated per Capita (lb/yr)	Recycling rate (percent of waste recycled)
2003	6.85	NA
2001	8.69	0.03
1999	9.61	0.08
1997	9.4	0.15
1995	9.71	0.12
1993	7.34	NA
average	**8.60**	**0.10**

(Nevada DEP, 2004)

In addition to the aforementioned parameters, it was also necessary to adopt the EPA's recommended default values for methane generation rate, methane generation potential and temperature as no local information was available. It was then possible to use the AP-42 formulas to calculate methane, NMOC and air toxic emissions. Not knowing whether landfills in

Clark County were used for co-disposal, the AP-42 default concentrations of benzene, NMOC and toluene for “No or Unknown co-disposal” were used.

Emissions from landfills are assumed to be constant year-round, without any day-of-week variation (EIIP, 2001e).

Sample Calculations

$E_{CH4} = L * R * (e^{(-kc)} – e^{(-kt)})$
$Q_{NMOC} = 1.82 * E_{CH4} * C_{NMOC} / (1x10^6)$
$E_{NMOC,UC} = Q_{NMOC} * MW_{NMOC} * 1 \text{ atm} / [(8.205x10^{-5} m^3\text{-atm/gmol - k}) * 1000g/kg * (273 + T)]$
$E_{NMOC,C} = E_{NMOC,UC} * (1-CE*FE)$

where: E_{CH4} = Annual emission of methane (m^3/year)
L = Methane generation potential (m^3/Mg)
R = Average annual refuse acceptance rate (Mg/year)
k = Methane generation rate constant ($year^{-1}$)
c = Time since landfill closure (years)
t = Time since initial refuse placement (years)
Q_{NMOC} = Emission rate of NMOC (m^3/year)
C_{NMOC} = Concentration of NMOC in landfill gas (ppmv)
$E_{NMOC,UC}$ = Uncontrolled mass emission of pollutant NMOC (kg/year)
MW_{NMOC} = Molecular weight of NMOC (g/gmol)
T = Temperature of landfill gas (°C)
$E_{NMOC,C}$ = Controlled mass emission of pollutant NMOC (kg/year)
CE = emissions control collection efficiency
FE = emissions control flare efficiency

A sample calculation using these equations is:

L = 100 m^3/Mg (AP42 recommended default)
k = 0.02/year (AP42 recommended default)
R = 1,156,000 Mg/year
c = 0 (assumed all landfills still open)
t = 25 yrs
C_{NMOC} = 595 ppmv NMOC as hexane (AP42 recommended default)
MW_{NMOC} = 86.18 g/gmol
T = 25 C (AP42 recommended default)
CE = 0.75
FE = 0.99

$E_{CH4} = L * R * (e^{(-kc)} – e^{(-kt)})$
$E_{CH4} = 100 * 1{,}156{,}000 (e^{(-0.02*0)} – e^{(-0.02*25)})$
$E_{CH4} = 45{,}000{,}000 m^3/year$

$Q_{NMOC} = 1.82 * E_{CH4} * C_{NMOC} / (1x10^6)$
$Q_{NMOC} = 1.82 * 45{,}000{,}000 * 595 / (1x10^6)$
$Q_{NMOC} = 49{,}000 m^3/year$

$E_{NMOC,UC} = Q_{NMOC} * MW_{NMOC} * 1\ atm / [(8.205x10^{-5}\ m^3\text{-atm/gmol - k}) * 1000g/kg * (273 + T)]$
$E_{NMOC,UC} = 49{,}000 * 86.18 * 1\ atm / [8.205x10^{-5} * 1000 * (273 + 25)]$
$E_{NMOC,UC}$ = 170,000 kg NMOC or 190 tons of NMOC

$E_{NMOC,C} = E_{NMOC,UC} * (1\text{-}CE*FE)$
$E_{NMOC,C} = 170{,}000 * (1 – 0.75 * 0.99)$
$E_{NMOC,C}$ = 44,000 kg NMOC or 49 tons of NMOC

GASOLINE DISTRIBUTION

Emissions from gasoline distribution are divided into three segments: Stage I, Stage II and storage tank breathing. Stage I emissions are those associated with the delivery of gasoline to gas stations (i.e., from the tanker truck into the underground storage tank). Stage II emissions are those that occur at the pump when fuel is transferred to vehicles. Emissions from these processes are estimated as the product of emission factors and activity level. Activity for this category is gasoline throughput and vehicle miles traveled (VMT) in Clark County (Clark County DAQEM, 2005d).

For each segment of gasoline distribution there is a distinct emission factor, as presented in Table 3-37. The EIIP document presents several emission factors for underground tank filling based on the filling practices in the state. The factor for submerged underground tank filling was used in combination with vapor recovery control efficiency based on Clark County regulations (Clark County DAQEM, 2005a), which require such filling and controls.

Table 3-37. Gasoline distribution emission factors.

Emission Factors		lb VOC/1000 gal gasoline throughput	Source
Stage I	Empty truck in transit	0.055	EIIP, 2001f
	Full truck in transit	0.005	EIIP, 2001f
	Submerged filling	7.3	EIIP, 2001f
Stage II	Refueling: Spillage and Displacement losses	varies	EPA MOBILE6.2
	Underground tank breathing and emptying	1.0	EIIP, 2001f

In the case of trucks in transit, the activity of total gasoline throughput was adjusted as suggested by the EIIP document to correct for gasoline that is transported more than once. The adjustment used was to multiply throughput by a factor of 1.25 (EIIP, 2001f).

Clark County staff perform annual inspections of Stage I and Stage II control equipment. Additionally, Clark County DAQEM regulations require Stage I and Stage II equipment be certified to reduce emissions by 95% or more for gasoline dispensing facilities with a throughput greater than 96,000 gallons/year. Based on inspection frequency, certification efficiency, and throughput waiver, a Stage I and Stage II control efficiency of 84% was used in emissions calculations from Stage I filling and Stage II refueling (per EPA, 1991 guidance).

Stage II emission factors were derived from EPA's MOBILE 6.2 on-road vehicles emission factor model. Clark County winter and summer MOBILE 6.2 inputs were provided by Clark County as used for winter CO and summer ozone SIP modeling. Stage II controls are in effect for much but not all of Clark County, as shown in Figure 3-1. For this reason both controlled and uncontrolled stage II emission factors were used.

The Stage II controlled emission factors were applied to the gasoline fueled vehicle miles traveled (VMT) in the Las Vegas Valley, and the uncontrolled factor was applied to the remaining VMT in the county. Highway Performance Monitoring System (HPMS) VMT data are available for the total county VMT, and the VMT in the Valley was derived from the 2002 transportation modeling performed by the Regional Transportation Commission. The VMT mix provided by DAQEM was applied to the VMT to derive gasoline vehicle VMT.

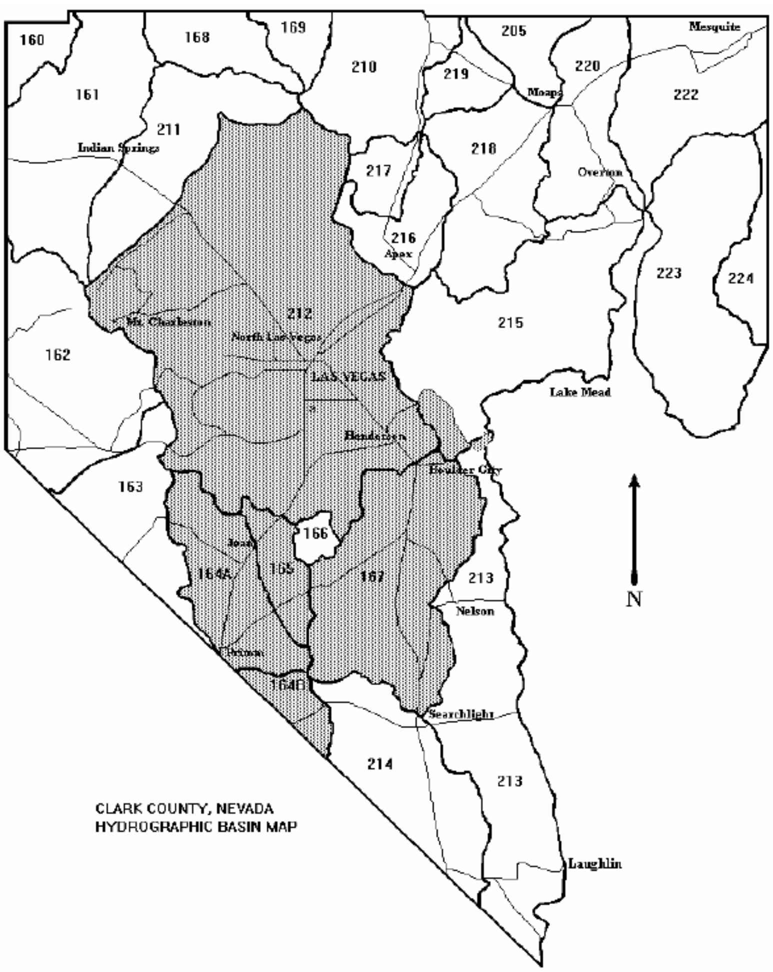

Figure 3-1. Clark County Stage II refueling control area of applicability.

Emissions of hazardous air pollutants were estimated based on the speciation profile provided in the EIIP document.

Seasonal allocation was based on monthly fuel sales data for Nevada. Monthly fuel sales data were obtained from the EIA (EIA, 2005b). Annual emissions were allocated to months based on the fraction of annual sales occurring in each month (presented in Table 3-38). Weekly allocation factors provided by the EPA are presented in Table 3-39.

Table 3-38. Monthly Nevada state allocation factors for fuel sales.

Month	Fraction of Annual Sales
December	7.8%
November	7.9%
October	8.5%
September	7.8%
August	8.6%
July	8.0%
June	8.3%
May	9.0%
April	8.9%
March	8.5%
February	8.4%
January	8.5%

(EIA, 2005b)

Table 3-39. Weekly activity for fuel distribution.

Process	Days per Week
Trucks in Transit	6
Fuel Delivery to Outlets	6
Vehicle Refueling	7
Storage Tank Breathing	7

(EIIP, 2001f)

Sample Calculations

Emissions from Trucks in Transit

$$E_{VOC,T} = TAF * (EF_{VOC,ET} + EF_{VOC,FT}) * GS_{2002} / 2000$$

where: GS_{2002} = 2002 State annual gasoline sales (1000 gal)
TAF = Transportation adjustment factor for fuel shipped more than once.
$E_{VOC,T}$ = Emission from trucks in transit (tons VOC/year)
$EF_{VOC,ET}$ = Emission factor for empty trucks (lb VOC/1000 gal transported)
$EF_{VOC,FT}$ = Emission factor for full trucks (lb VOC/1000 gal transported)

A sample calculation using this equation for estimating VOC from trucks in transit in Clark County is:

GS_{2002} = 645,056,960 (gal) (Clark County DAQEM, 2005c)
TAF = 1.25 (EIIP, 2001f recommended default)
$EF_{VOC,ET}$ = 0.055 (lb VOC/1000 gal transported)
$EF_{VOC,FT}$ = 0.005 (lb VOC/1000 gal transported)
$E_{VOC,T}$ = TAF * ($EF_{VOC,ET}$ + $EF_{VOC,FT}$) * GS_{2002} / 2000
$E_{VOC,T}$ = 1.25 * (0.055 + 0.005) * 645,000 / 2000
$E_{VOC,T}$ = 24.2 tons VOC/year

Emissions from Delivery of Fuel (Submerged Filling with vapor recovery)

$E_{VOC,D} = EF_{VOC,D} * GS_{2002} * (1-CE) / 2000$

where: $E_{VOC,D}$ = Emission from delivery of fuel (tons VOC/year)
$EF_{VOC,D}$ = Emission factor for delivery (lb VOC/1000 gal delivered)
CE = control efficiency

A sample calculation using this equation for estimating VOC from trucks delivery of fuel in Clark County is:

where: $EF_{VOC,D}$ = 7.3 (lb VOC/1000 gal delivered)
CE = 84%

$E_{VOC,D}$ = $EF_{VOC,D}$ * GS_{2002} * CE / 2000
$E_{VOC,D}$ = 7.3 / 1000 * 645,056,960 * (1 - 84%) / 2000
$E_{VOC,D}$ = 377 tons VOC/year

Emissions from Vehicle Refueling: Spillage and Displacement Losses

$E_{VOC,SII} = (E_{VOC,C} + E_{VOC,U}) * 365$

where: $E_{VOC,SII}$ = Vehicle stage II refueling loss emissions (tons VOC/yr)
$E_{VOC,C}$ = Vehicle controlled stage II annual refueling loss emissions (tons VOC/day)
$E_{VOC,U}$ = Vehicle uncontrolled stage II annual refueling loss emissions (tons VOC/day)

$E_{VOC,C} = (EF_{VOC,C,S} + EF_{VOC,C,W,}) * VMT_{C,G} / 2 / 907{,}185$

where: $EF_{VOC,C,S}$ = Stage II refueling losses with controls summer season emission factor (g/mi)
$EF_{VOC,C,W}$ = Stage II refueling losses with controls winter season emission factor (g/mi)
$VMT_{C,G}$ = Stage II controlled area gasoline vehicle VMT (mi/day)

$E_{VOC,U} = (EF_{VOC,U,S} + EF_{VOC,U,W}) * VMT_{U,G} / 2 / 907{,}185$

where: $EF_{VOC,U,S}$ = Stage II refueling losses without controls summer season emission factor (g/mi)
$EF_{VOC,U,W}$ = Stage II refueling losses without controls winter season emission factor (g/mi)
$VMT_{U,G}$ = Stage II uncontrolled area gasoline vehicle VMT (mi/day)

A sample calculation using these equations for estimating VOC from vehicle refueling in Clark County is:

where: $EF_{VOC,C,S}$ = 0.042 g/mi
$EF_{VOC,C,W}$ = 0.031 g/mi
$VMT_{C,G}$ = 27,977,483 mi/day
$EF_{VOC,U,S}$ = 0.186 g/mi
$EF_{VOC,U,W}$ = 0.118 g/mi
$VMT_{U,G}$ = 5,653,294 mi/day

$E_{VOC,C} = (EF_{VOC,C,S} + EF_{VOC,W,})* VMT_{C,G} / 2 / 907{,}185$
$E_{VOC,C} = (0.042 + 0.031) *27{,}977{,}483 / 2 / 907{,}185$
$E_{VOC,C}$ = 1.126 tons/day

$E_{VOC,U} = (EF_{VOC,U,S} + EF_{VOC,U,W})* VMT_{U,G} / 2 / 907{,}185$
$E_{VOC,U} = (0.186 + 0.118) * 5{,}653{,}294 / 2 / 907{,}185$
$E_{VOC,U}$ = 0.947 tons/day

$E_{VOC,SII} = (E_{VOC,C} + E_{VOC,U}) * 365$
$E_{VOC,SII} = (1.126 + 0.947) * 365$
$E_{VOC,SII}$ = 757 tons/yr

To calculate seasonal emissions for all gasoline distribution processes except refueling, the following equation was used:

$$SE = AE * FS / [DS * (DW / 7)]$$

where: SE = Seasonal Emission
AE = Annual E mission
FS = Fraction of activity occurring during this season
DS = Number of days in the season (91 for winter, 92 for summer)
DW = Days per week that the activity occurs

To calculate seasonal emissions for refueling, gasoline vehicle VMT was multiplied by the appropriate seasonal stage II refueling emission factor.

Emissions from Tank Breathing

$$E_{VOC,TB} = EF_{VOC,TB} * GS_{2002} / 2000$$

where: $E_{VOC,TB}$ = Emission from tank breathing (tons VOC/yr)
$EF_{VOC,TB}$ = Emission factor for tank breathing (lb VOC/1000 gal delivered)

A sample calculation using this equation for estimating VOC from tank breathing in Clark County is:

$EF_{VOC,TB}$ = 1.0 (lb VOC/1000 gal delivered)
$E_{VOC,TB} = EF_{VOC,TB} * GS_{2002} / 2000$
$E_{VOC,TB}$ = 1.0 / 1000 * 645,056,960 / 2000
$E_{VOC,TB}$ = 323 tons/yr

BAKERIES

Annual Emissions

This category covers emissions from yeast leavening of baked goods at commercial and retail bakeries. There are two types of yeast dough mixing processes commonly used in bakeries: sponge-dough and straight dough. The sponge dough process, most commonly used at commercial bakeries, produces the largest amount of VOC emissions. The straight dough process is primarily used by retail bakeries and has much lower VOC emissions.

To estimate annual VOC emissions from bakeries, per-capita consumption was estimated using a per capita consumption factor of 70 lb/person (EIIP, 1999). This emission factor was applied to the Clark County 2002 population to estimate total 2002 bread consumption. It was assumed that 2002 Clark County bread production was equal to 2002 consumption, and it was conservatively assumed that all bread consumed was from sponge dough processes. An emission factor of 5 lbs VOC / 1000 lbs baked (EIIP, 1999) was used to relate Clark County production to emissions.

Seasonal Emissions

Average summer and winter weekday emissions were calculated by dividing total annual emissions by 365 in accordance with the EIIP document which suggests that bakery production is relatively uniform annually and daily (EIIP, 1999).

Sample Calculations

$E_{VOC} = P * CF * EF_{VOC} / 2000lb/ton$

where: E_{VOC} = Annual emission of VOC (tons);
P = 2002 Population;
EF_{VOC} = VOC per-capita emission factor (lbs VOC/ 1000 lb baked)
CF = per capita, consumption factor (lb/person-year)

A sample calculation using this equation for estimating VOC for bakeries is as follows:

where: P = 1,578,332;
EF_{VOC} = 5 lb VOC / 1000 lb baked

E_{VOC} = P * CF *EF_{VOC} / 2000 lb/ton
E_{VOC} = 1,578,332 * 5/1000 * 70 /2000 lb/ton = 276 ton/year;

VEHICLE FIRES

Annual Emissions

This category covers emissions from accidental vehicle fires. Emissions from vehicle fires were estimated based on the number of vehicle fires in 2002 in Clark County (Table 3-40), EIIP reported emission factors (Table 3-41), and the average amount of components burned per vehicle fire (500 lb/vehicle, EIIP, 2000b).

Table 3-40. Number of 2002 Clark County vehicle fires.

Fire Department	Number of Vehicle Fires	Source
Clark County	874	(CCFD, 2005)
City of Las Vegas	587	(LVFD, 2005)
City of Boulder	36	(BFD, 2005)
City of Henderson	210	(HFD, 2005)
City of North Las Vegas	240	(NLVFD, 2005)
Total	1947	

Table 3-41. Vehicle fire emission factors.

Pollutant	Emission Factor (lbs/ton burned)
PM	100
CO	125
VOC	32
NOx	4

(EIIP, 2000b)

Although HAPs are undoubtedly emitted during vehicle fires, there was insufficient information pertaining to HAP emission factors in either AP-42 or EIIP sources. Therefore, HAP emissions were not calculated for vehicle fires.

Seasonal Emissions

According to EIIP documentation there is no data available regarding temporal allocations from vehicle fires (EIIP, 2000b), so summer and winter average day emissions were calculated by dividing total annual emissions by 365.

Sample Calculations

*E = VF * EF / 2000 lb/ton * B / 2000 lb/ton*

where: E = Annual emissions (tons/year);
VF = 2002 vehicle fires

EF = vehicle fire emission factor (lb/ton burned)
B = weight of burnable components per fire (lb)

A sample calculation using this equation for estimating VOC for vehicle fires is as follows:

where: VF = 1947 fires
EF_{VOC} = 32 lb/ton burned
B = 500 lb/fire

E_{VOC} = VF * EF_{VOC} / 2000 lb/ton * B / 2000 lb/ton
E_{VOC} = 1947 * 32 / 2000lb/ton * 500 / 2000lb/ton = 7.8 tons

STRUCTURAL FIRES

Annual Emissions

This category covers emissions from accidental structural fires that occur in residential or commercial structures. Emissions from structural fires were estimated based on the number of structural fires in 2002 in Clark County (Table 3-42), EIIP reported emission factors (Table 3-43), and the average fuel loading per structural fire (1.15 tons/fire, EIIP, 2001g).

Table 3-42. Number of 2002 Clark County vehicle fires.

Fire Department	Number of Vehicle Fires	Source
Clark County	888	(CCFD, 2005)
City of Las Vegas	2039	(LVFD, 2005)
City of Boulder	14	(BFD, 2005)
City of Henderson	105	(HFD, 2005)
City of North Las Vegas	186	(NLVFD, 2005)
Total	3232	

Table 3-43. Vehicle Fire emission factors.

Pollutant		Emission Factor
Criteria	PM	10.8
	VOC	11
	NOx	1.4
	CO	60
HAP	Hydrogen cyanide	35.49
	Formaldehyde	1.02
	Acrolein	4.41
	Hydrochloric acid	15.11

(EIIP, 2001g)

Seasonal Emissions

Summer and winter average day emission estimates were made based on the assumption of year-round temporal uniformity of structural fire occurrence.

Sample Calculations

*E = SF * EF / 2000 lb/ton * FL*

where: E = Annual emissions (tons);
SF = 2002 structural fires
EF = structural fire emission factor (lb/ton burned)
B = fuel loading factor (tons)

A sample calculation using this equation for estimating VOC for structural fires is as follows:

where: SF = 3232 fires
EF_{VOC} = 11 lb/ton burned
FL = 1.15 tons/fire

E_{VOC} = SF * EF_{VOC} / 2000 lb/ton * FL
E_{VOC} = 3232 * 11 / 2000lb/ton * 1.15 = 20.4 tons

WASTEWATER

Annual Emissions

The treatment of wastewater involves many emissions generating processes. Procedures to estimate emissions from each process are detailed in EIIP Volume II, Chapter 5 and AP-42 Section 4.3 (EPA, 1995). The AP-42 methods require the parameters of the equipment at the wastewater facility and substantial information about the characteristics of the wastewater processed. Using these methods for estimating emissions from wastewater was beyond the scope of this report.

After a review of potential methodologies for estimating wastewater treatment emissions, the 2002 NEI methodology was chosen as it is well documented and served to estimate average emissions typical of wastewater treatment processes. This methodology requires wastewater treatment plant flow rates (Table 3-44) be applied to emission factors (Tables 3-45 and 3-46) to obtain emissions estimates.

One wastewater treatment facility, City of Las Vegas WPCF, is included in the major point sources; and was therefore not included in the area source wastewater treatment emissions.

Table 3-44. Clark County wastewater treatment plant annual flow rates.

Treatment Plant	Annual Flow Rate (MMG)
City of Henderson POTW	8322
City of Las Vegas: NW Water Resource Center	1278
Clark County Sanitation District: Flamingo	30580
City of Las Vegas: WPCF	21630
Clark County Sanitation District: Laughlin	1128

(Source: Clark County DAQEM, 2005d; Clark County Sanitation District, 2005)

Table 3-45. Wastewater treatment VOC emission factor.

Pollutant	Emission Factor (lbs/MMG)
VOC	8.9

(U.S. EPA, 2004a)

Table 3-46. Wastewater treatment HAP emission factors.

Pollutant	Emission Factor (lbs/MMG)
1,1,2,2-Tetrachloroethane	2.04E-05
1,1,2-Trichloroethane	1.36E-05
1,2,4-Trichlorobenzene	1.01E-03
1,3-Butadiene	2.92E-04
1,4-Dichlorobenzene	2.51E-03
1-Chloro-2,3-Epoxypropane	5.26E-05
2,4-Dinitrotoluene	5.60E-04
2-Nitropropane	3.40E-06
Acetaldehyde	3.61E-03
Acetonitrile	4.02E-03
Acrolein	4.47E-03
Acrylonitrile	4.50E-03
Allyl Chloride	2.26E-04
Benzene	7.84E-02
Benzyl Chloride	9.51E-05
Biphenyl	8.76E-04
Carbon Disulfide	5.03E-02
Carbon Tetrachloride	1.31E-02
Chlorobenzene	5.63E-03
Chloroform	7.50E-02
Chloroprene	2.77E-04
Cresols (includes o,m,p)	1.87E-05
Dimethyl Sulfate	1.53E-05
Ethyl Acrylate	2.04E-05
Ethyl benzene	8.92E-02
Ethylene Oxide	2.58E-03
Formaldehyde	2.29E-04
Glycol Ethers	1.34E-01
Hexachlorobutadiene	8.49E-06
Hexachlorocyclopentadiene	6.79E-06

Pollutant	Emission Factor (lbs/MMG)
Methanol	1.33E-01
Methyl Chloroform (1,1,1-Trichloroethane)	6.56E-03
Methyl Ethyl Ketone (2-Butanone)	3.31E-02
Methyl Isobutyl Ketone (Hexone)	3.13E-02
Methyl (Methacrylate)	3.62E-03
Methyl tert-Butyl Ether	7.42E-04
Methylene Chloride	1.06E-01
N,N-Dimethylaniline	3.75E-03
Naphthalene	1.53E-02
Nitrobenzene	7.64E-05
o-Toluidine	2.04E-05
P-Dioxane	2.09E-04
Propionaldehyde	4.08E-05
Propylene Dichloride	1.34E-04
Propylene Oxide	8.53E-03
Styrene	3.18E-02
Tetrachloroethylene	4.97E-02
Toluene	1.43E-01
Trichloroethylene	3.56E-03
Vinyl Acetate	8.92E-04
Vinyl Chloride	7.81E-05
Vinylidene Chloride	4.93E-03
Xylenes (includes o, m, and p)	6.96E-01

(U.S. EPA, 2005a)

Seasonal Emissions

Uniform year round emissions were assumed, so summer and winter average day emissions were calculated by dividing total annual emissions by 365.

Sample Calculations

$E_{VOC} = Q * EF_{VOC} / 2000$ *lb/ton*
$E_{TCHA} = Q * EF_{TCA} / 2000$ *lb/ton*

where: E_{VOC} = Annual VOC emissions (tons/year);
Q = annual wastewater flow (MMG)
EF_{VOC} = VOC emission factor (lb/MMG)
E_{TCA} = Annual tetrachloroethane (TCA) emissions (tons/year);
EF_{TCA} = TCA emission factor (lb/MMG)

A sample calculation using this equation for estimating VOC and TCA emissions from the Clark County Sanitation District, Flamingo facility is as follows:

where: EF_{VOC} = 8.9 lb/MMG
$EF_{TCA} = 2.04x10^{-5}$ lb/MMG
Q = 30580

$E_{VOC} = Q * EF_{VOC}$ / 2000 lb/ton
E_{VOC} = 30580 * 8.9 / 2000 lb/ton = 136 tons

$E_{TCA} = Q * EF_{TCA}$ / 2000 lb/ton
$E_{TCA} = 30580 * 2.04x10^{-5}$ / 2000 lb/ton = $3.1x10^{-4}$ tons

AREA SOURCES EMISSIONS RESULTS

As stated at the beginning of this section, all of the spreadsheets and supporting data used to estimate area source emissions have been provided to Clark County DAQEM. Each source category has a separate spreadsheet, and the emissions for each SCC are provided in those spreadsheets. In addition, ENVIRON has provided a linked area source emissions summary spreadsheet that provides annual, summer weekday, and winter weekday emissions for all area sources by SCC, for all pollutants. This area source emissions summary spreadsheet includes all of the work described in this section, and also incorporates the consumer products VOC emissions estimated in a separate study (MACTEC, 2005).

Figures 3-2 through 3-8 graphically portray the 2002 annual emissions by source category for each pollutant. Emissions were estimated for only those area sources that emit ozone precursors; sources that are exclusively ammonia (NH3) or particulate matter (PM) are not included. The PM and NH3 figures are therefore not what is seen in a typical full area sources distribution.

Significant contributors to area source VOC emissions are degreasing (16%), industrial surface coating (18%), architectural coatings (13%), consumer products (15%), residential wood combustion (9%), and gasoline distribution (9%). Area source NOx emissions are dominated by fuel combustion emissions (97%). CO emissions are dominated by residential wood combustion (80%) and fuel combustion (17%). Area source SOx emissions are virtually all associated with fuel combustion. PM10 area source emissions are dominated by fuel combustion (21%) and residential wood combustion (73%). PM2.5 area source emissions are dominated by residential wood combustion (73%) and fuel combustion (21%). Area source ammonia emissions are all associated with fuel combustion for the sources inventoried.

Figure 3-9 shows the distribution of 2002 summer VOC emissions. The largest contributors to summertime VOC emissions are industrial surface coating (24.6%), degreasing (18%), consumer products (15%), and architectural coatings (12%).

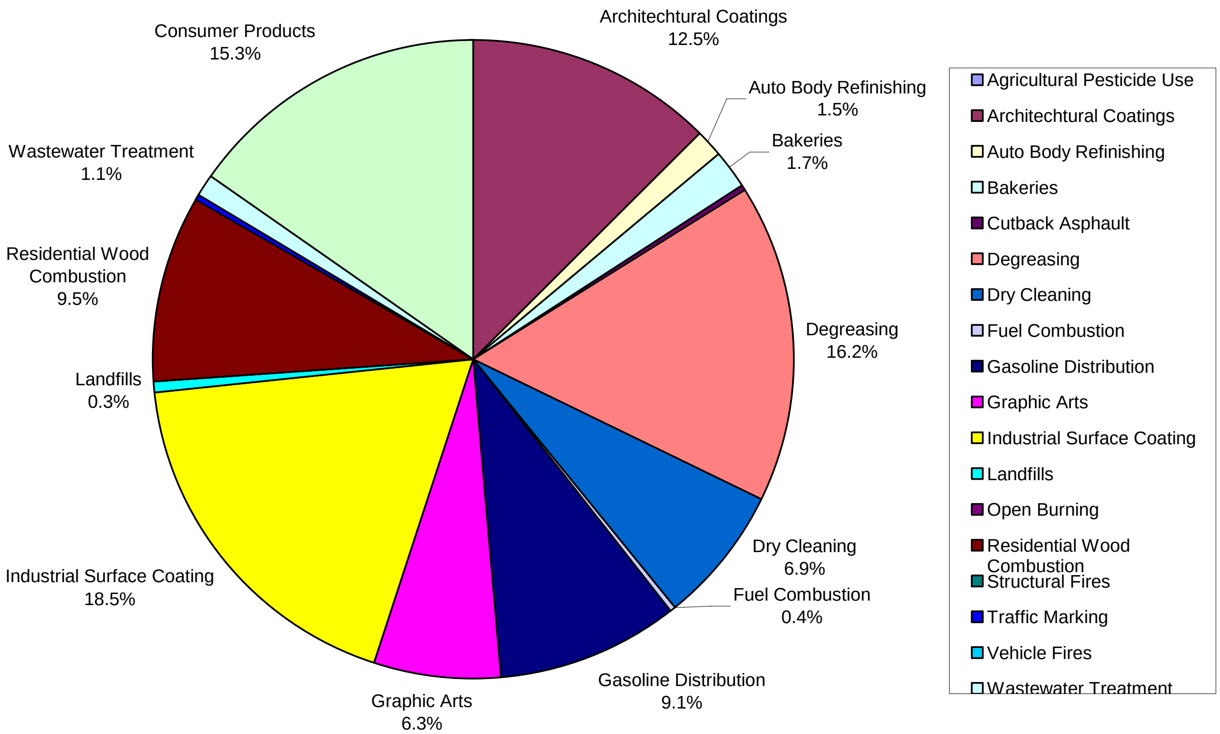

Figure 3-2. Clark County 2002 area source VOC emissions by source category.

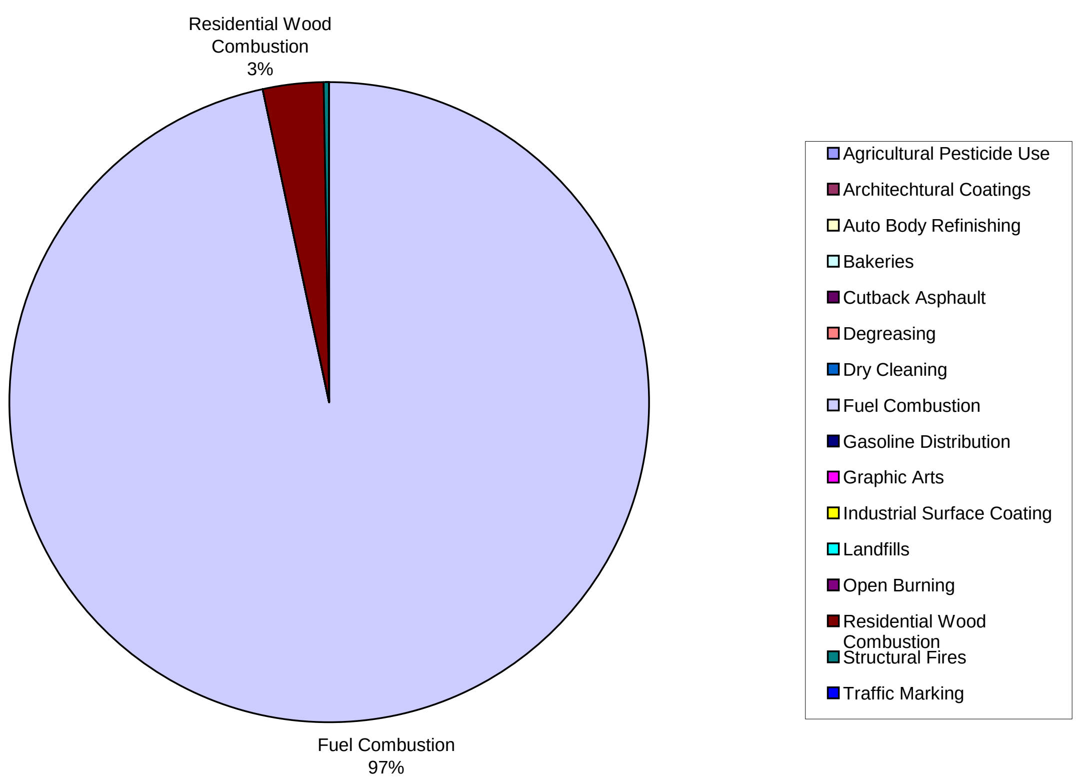

Figure 3-3. Clark County 2002 area source NOx emissions by source category.

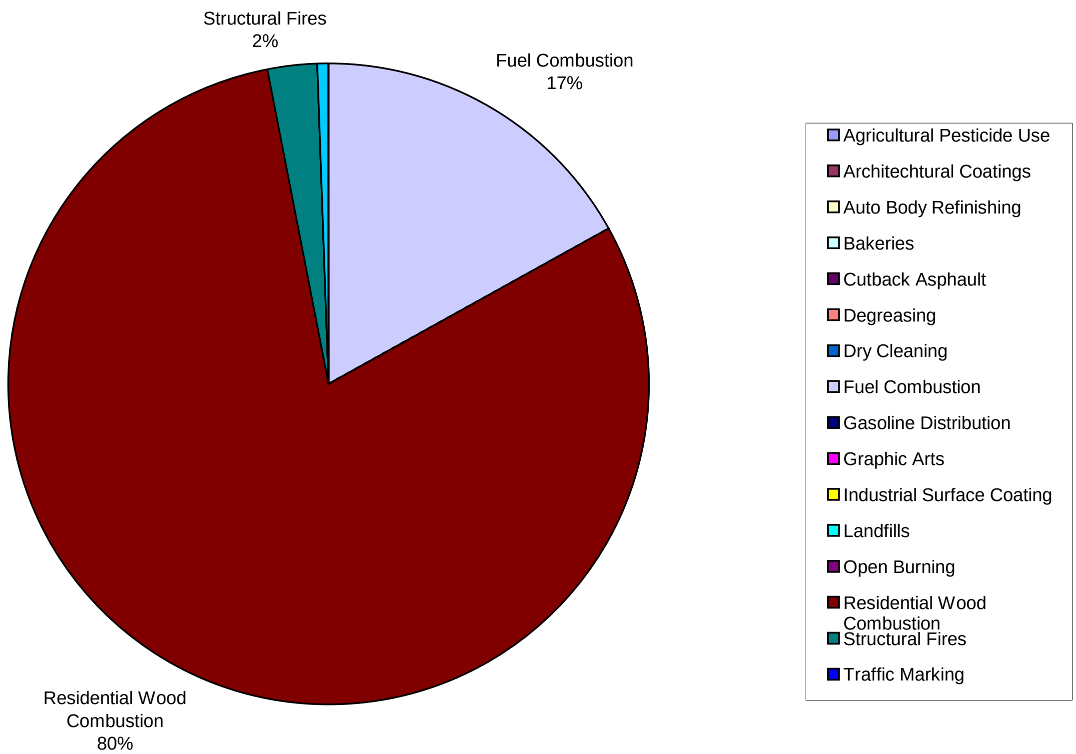

Figure 3-4. Clark County 2002 area source CO emissions by source category.

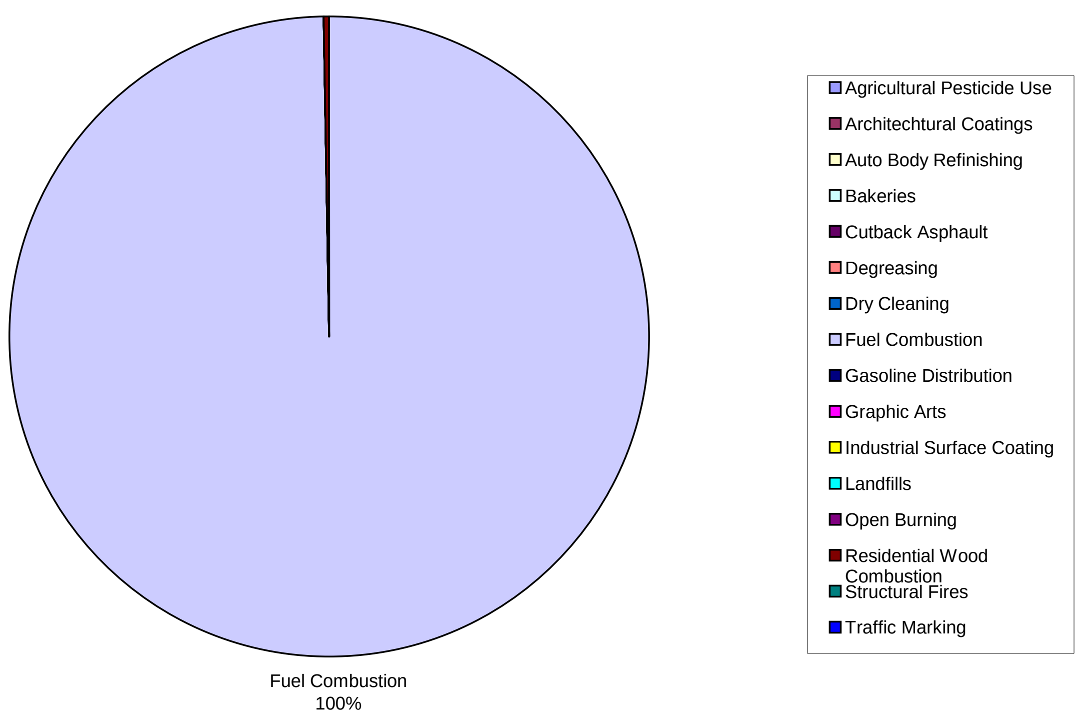

Figure 3-5. Clark County 2002 area source SOx emissions by source category.

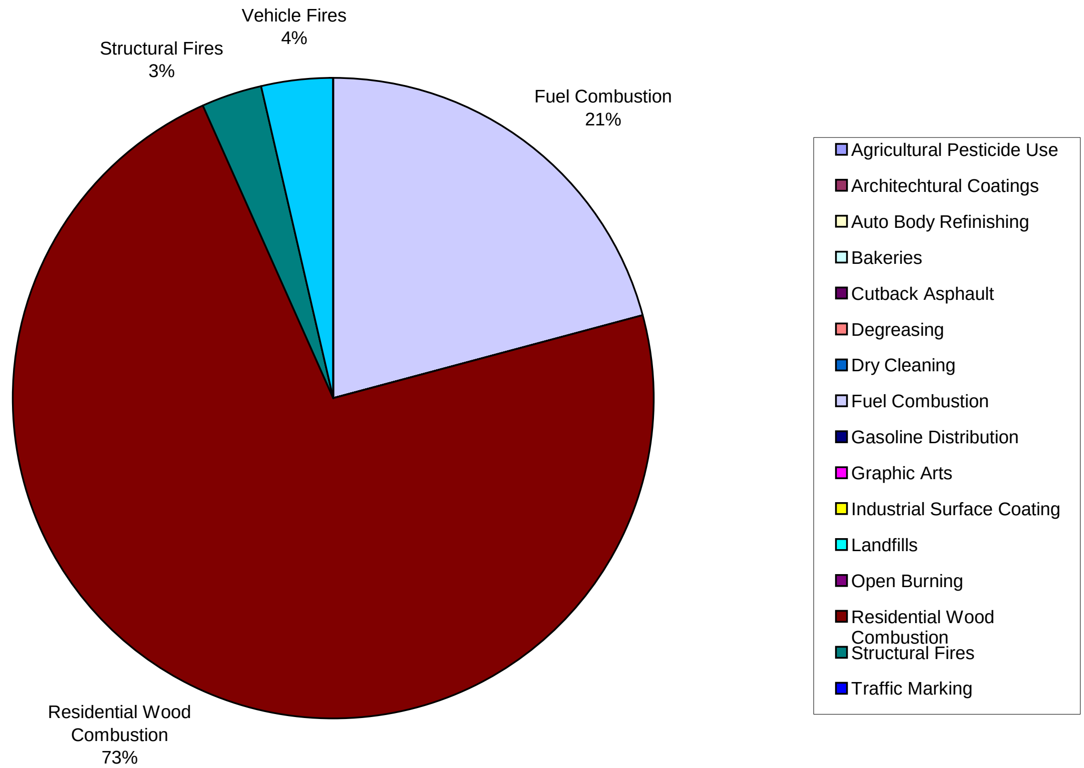

Figure 3-6. Clark County 2002 area source PM10 emissions by source category.

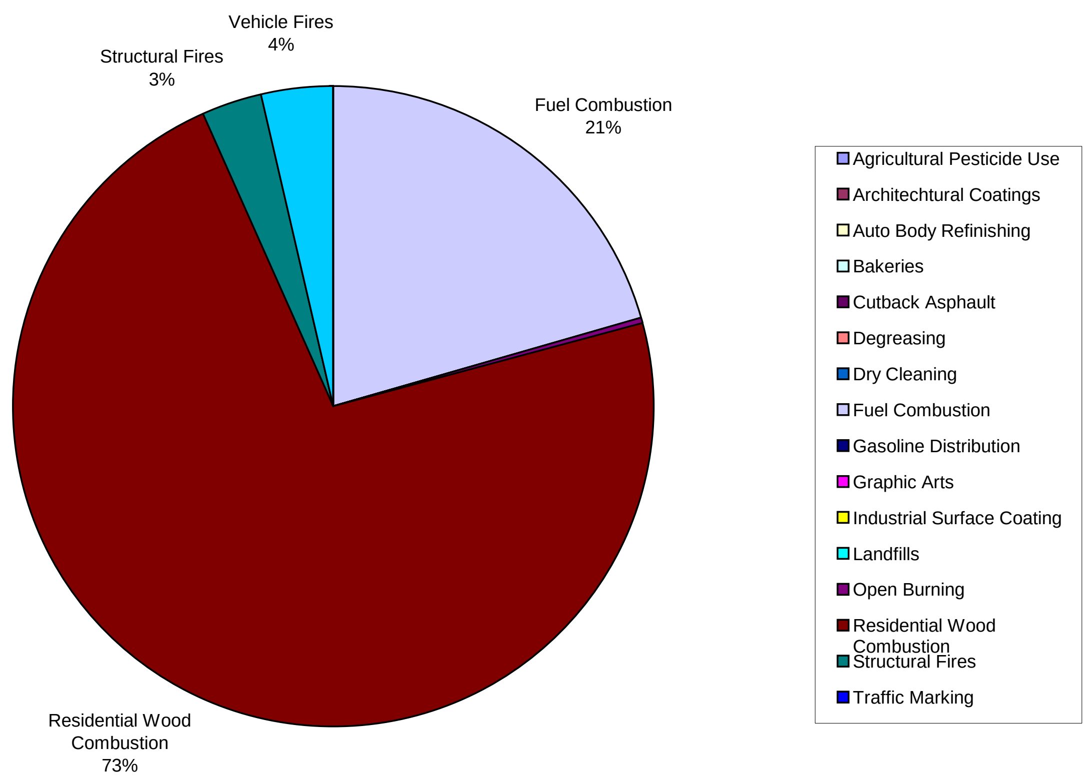

Figure 3-7. Clark County 2002 area source PM2.5 emissions by source category.

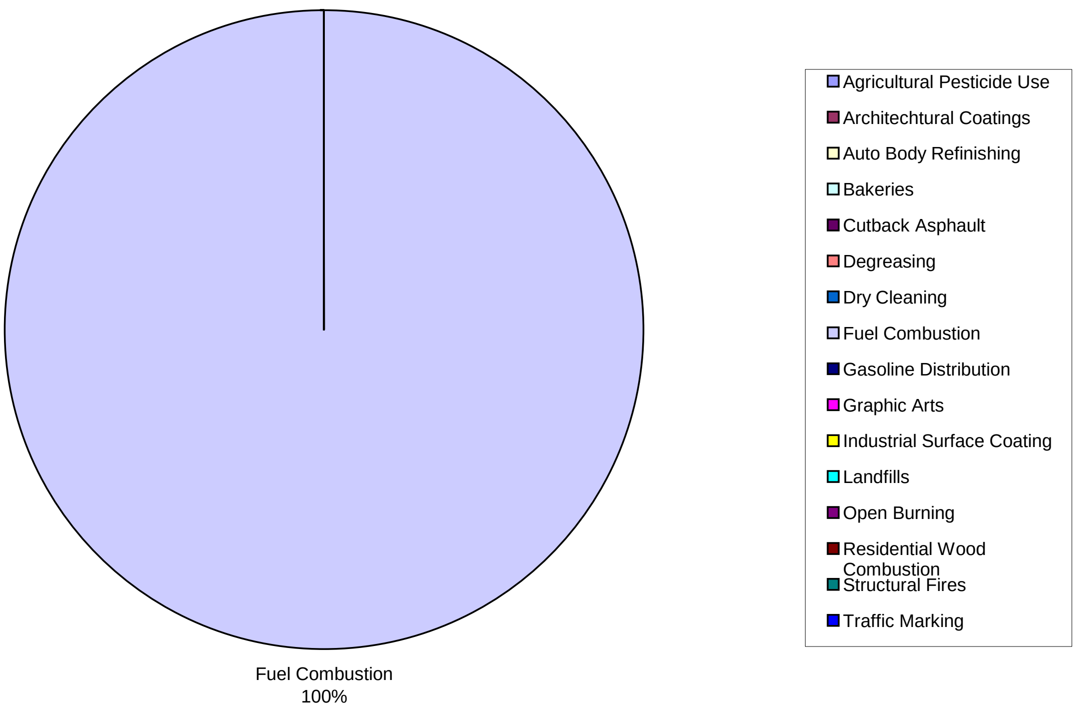

Figure 3-8. Clark County 2002 area source NH3 emissions by source category.

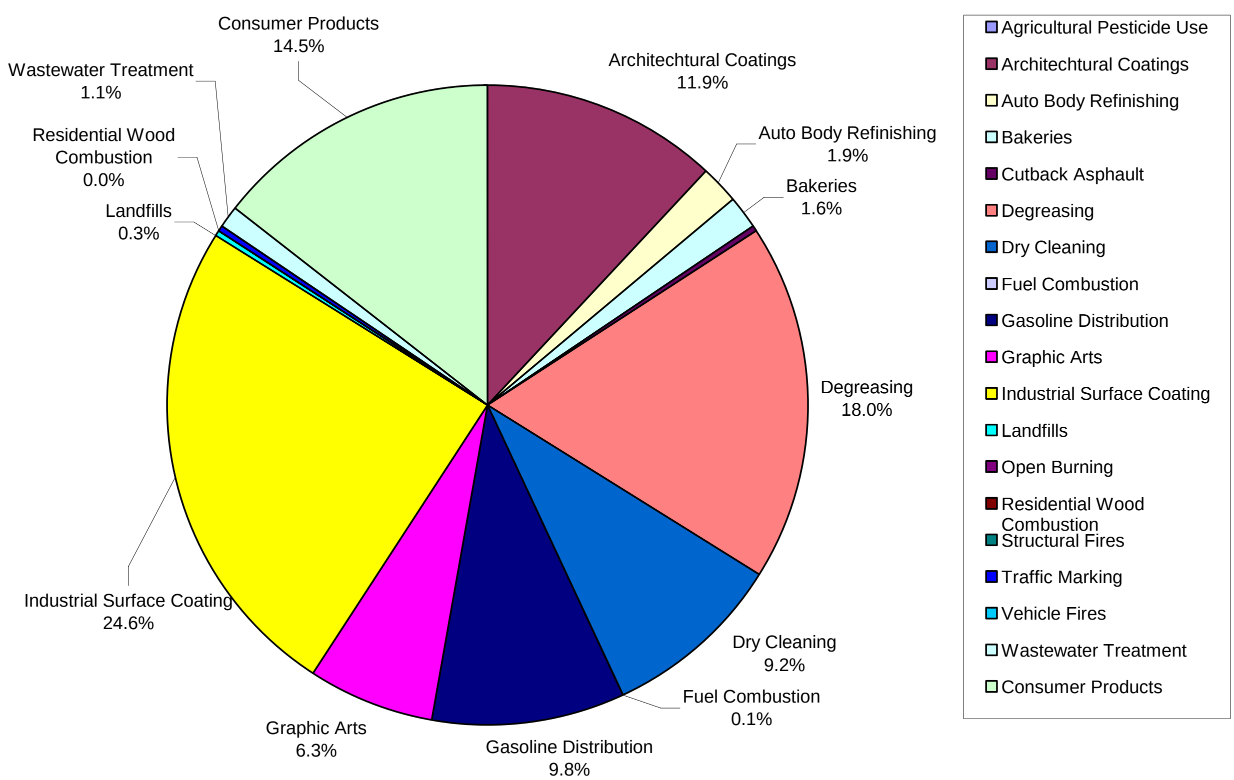

Figure 3-9. Clark County 2002 summer day area source VOC emissions by source category.

4. POINT AND AREA SOURCE PROJECTIONS

This section describes the characteristics (i.e., years, geographic domain and resolution, pollutants), methods used, and results of the future year projection emission inventories developed for point and area sources. All calculation spreadsheets, including growth and control factors, have been provided to Clark County DAQEM. At the end of the section, summary tables are provided that show the total tons/year for the criteria air pollutants (CAPs). The totals for the hazardous air pollutants (HAPs) are not provided in this report, but are contained within the spreadsheets that have been provided to Clark County DAQEM.

CHARACTERISTICS OF THE PROJECTION INVENTORIES

The following list describes the characteristics of the projection inventories:

- Years: 2003, 2008, 2013, and 2018. Note that for 2003 within Clark County, actual point source emissions were provided by DAQEM, therefore, only area source emissions were projected for 2003.
- Geographic domain: within Clark County, and within the states comprising the domain of the Western Regional Air Partnership (i.e., AZ, CA, CO, ID, MT, ND, NM, NV [excluding Clark County], OR, UT, WA, WY, plus 16 Native American Reservations [NARs]).
- Pollutants: CAPs and HAPs for Clark County; and NO_x, VOC, and CO for the remainder of the geographic domain (i.e., the WRAP states).

PROJECTIONS METHODOLOGY

The projections methodology builds upon recent work conducted by ERG for the WRAP for 2018 (ERG, 2006a). The WRAP methodology is described below, and is followed by a detailed explanation of how the WRAP methodology and results were either used directly or were modified to address the specific characteristics (e.g., years) of the Clark County project. The projections methodology documentation presented here is based on two technical memoranda that were previously sent to DAQEM (ERG, 2006b; ERG, 2006c).

Summary of WRAP Base Case Projections Methodology

The steps used to project the WRAP 2002 emissions inventory to 2018 are illustrated in the roadmap presented in Figure 4-1. The full WRAP methodology is described in detail in the final WRAP projections report (ERG, 2006a). The data and calculations for each of the layers in the Figure 4-1 roadmap were stored in an Excel spreadsheet for each state, and in a separate single spreadsheet for the WRAP tribes. The 2018 projections for California were developed by the California Air Resources Board (ARB) using the California Emission Forecasting System (CEFS) and then provided to ERG for the WRAP project. The types of information used in each step are summarized below:

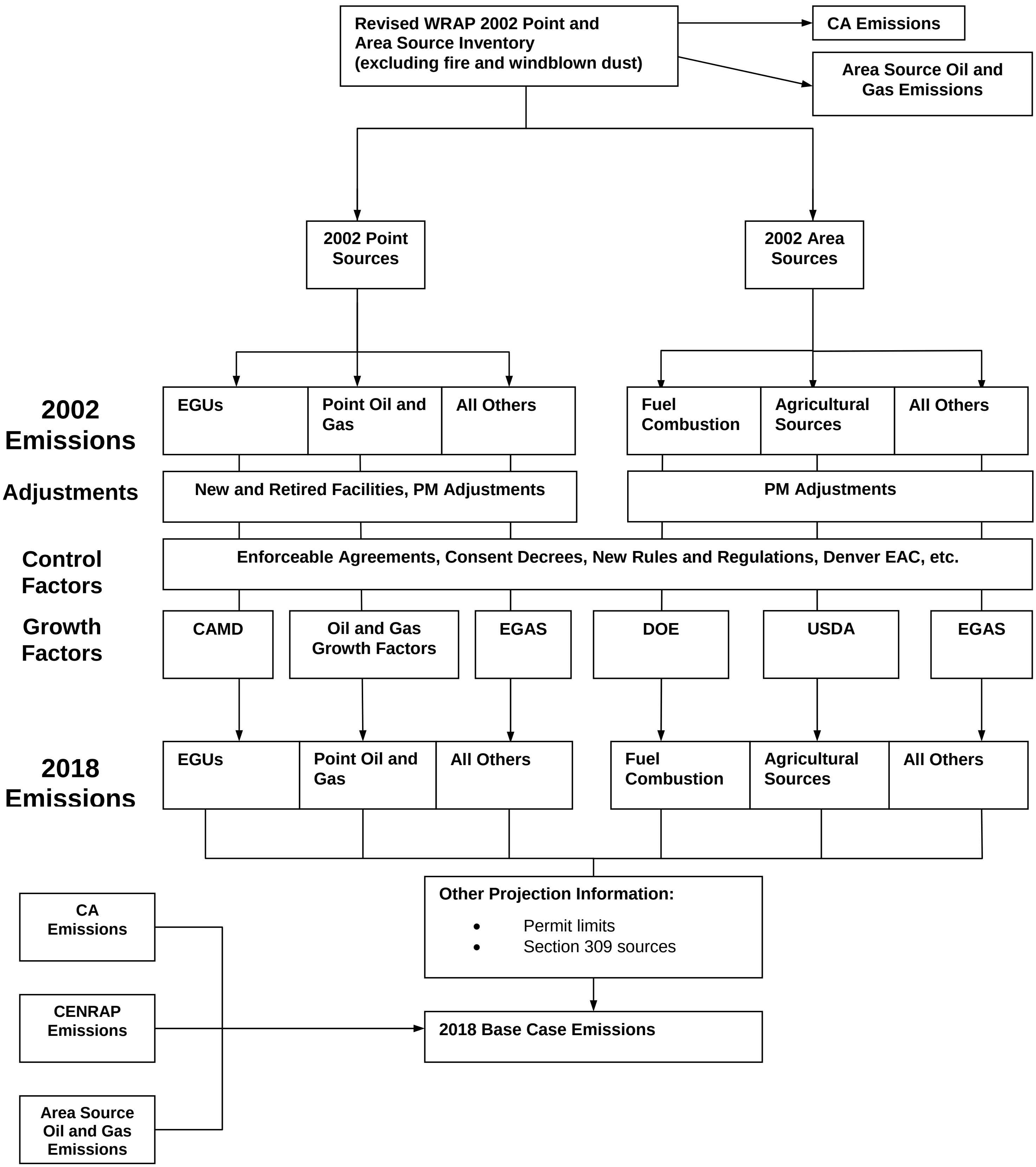

Figure 4-1. Roadmap for development of the WRAP 2018 Base Case Inventory.

- 2002 Emissions Inventory. The revised 2002 WRAP point and area source inventory was updated by ERG and ENVIRON for the WRAP and was used as the starting point of the projections. The following fields were included:

  - State and County FIPS
  - State facility identifier
  - Emission unit ID
  - Process ID
  - Pollutant code
  - Emission release point ID
  - Emission numeric value
  - Emission unit numerator
  - Tribal code
  - Primary SIC and NAICS
  - Facility name
  - City
  - SCC
  - BART flag (i.e., 1-Yes; 2-Likely; 3-Potential; 4-Do not know; 5-No)

- Adjustments. Certain adjustments were made to the revised 2002 WRAP point and area source inventory in order to reflect accurate base case projections, including:

  - Emissions for new facilities that came on-line since 2002
  - Corrections for facilities that permanently retired in 2003 or 2004

- Control Factors. Emission reductions due to known (i.e., "on-the-books") controls, consent decree reductions, SIP control measures, and other relevant regulations that have gone into effect since 2002 or will go into effect before the end of 2018 were taken into account. These controls do not include impacts from any future control scenarios that have yet to be determined.

- Growth Factors. Growth factors were applied to the 2002 WRAP point and area source inventory, including:

  - SCC-specific growth factors developed from the Economic Growth and Analysis System (EGAS), Version 5.0 projection factor model for most point and area sources (Abt, 2004; U.S. EPA, 2004b).
  - Oil and gas growth factors developed by ENVIRON (ENVIRON, 2005).
  - Energy Information Administration (EIA) energy projections used for area source fuel combustion categories (i.e., industrial, commercial/institutional, and residential) (EIA, 2005c).
  - U.S. Department of Agriculture (USDA) agricultural acreage projections used for agricultural source categories (USDA, 2005).
  - Special analysis of electricity generation unit (EGU) growth relative to unit capacity threshold (explained in more detail below).

- Retirement and Replacement Rates**.** The effects of point source retirement were estimated using SCC-specific annual retirement rates based on expected equipment lifetimes. Retired equipment were replaced by lower-emitting new equipment. For natural gas-fired EGUs, unit lifetimes were used instead of annual retirement rates. All coal-fired EGUs were assumed not to retire during the projection period from 2002 to 2018.

- Permit Limits**.** These were applied in cases where the projected emissions may have inadvertently exceeded an enforceable emission limit (i.e., emissions were adjusted downward to the permit limit, as applicable).

An extensive data collection effort was conducted to obtain the projection information described above. The actual data collected, adjustments made, factors calculated, and results are described in full detail in the WRAP report (ERG, 2006a).

WRAP EGU Projections – Because EGUs are the largest source of NO_x and SO_2 emissions in the WRAP inventory domain, the WRAP projections were developed on a facility-by-facility basis, rather than for the sector as a whole. NO_x and SO_2 emissions data were incorporated into the revised 2002 inventory for all EGUs that had continuous emissions monitors (CEMs) and reported to U.S. EPA's Clean Air Markets Division (CAMD) database (i.e., identified as "CAMD EGUs") (U.S. EPA, 2005b).

After making adjustments to the compiled list of CAMD EGUs (i.e., adding new EGUs that commenced operation after 2002 and removing EGUs that retired since 2002), then the following data were downloaded from the CAMD website for each of the units:

- Nameplate unit capacity (megawatts [MW])
- 2002 gross electricity generation (megawatt-hours [MWh])
- 2002 heat input (million British Thermal Units [MMBtu])
- 2002 NO_x emissions (tons per year [tpy])
- 2002 SO_2 emissions (tpy)
- 2004 NO_x emissions (tpy)
- 2004 SO_2 emissions (tpy)

For each CAMD EGU, a 2002 capacity factor (CF) was calculated using the following equation:

$$CF = (\text{gross electricity generation [MWh]})/(\text{nameplate unit capacity [MW]} \times 8760 \text{ hours})$$

After calculating the 2002 capacity factor, a capacity threshold (CT) was used to calculate the appropriate growth factor (GF) for each coal-fired EGU. The equation used was as follows:

$$GF = CT/CF$$

The CT value represents the theoretical level of generation at which electric utilities would need to begin construction of a new EGU to meet additional demand requirements. The CT value is dependent upon fuel and technology; the values used in the WRAP analysis were 0.85 for coal-fired EGUs, 0.50 for oil-/diesel-fired EGUs, 0.25 for simple cycle natural gas-fired turbines, and

0.60 for natural gas-fired combined cycle EGUs. The GF value represents how much growth is needed to project from the current level of operation up to the CT value.

In general, the 2002 emissions were then multiplied by the calculated GF value in order to determine the 2018 emissions using the following equation:

$$Emissions_{2018} = Emissions_{2002} \times GF$$

An expanded methodology was utilized for estimating future year NO_x and SO_2 emissions for the coal-fired EGUs, only. In this expanded methodology, the 2002 heat input (HI) was multiplied by the calculated GF to obtain a projected 2018 HI:

$$HI_{2018} = HI_{2002} \times GF$$

The most recent full-year (i.e., 2004) NO_x and SO_2 emission rates (ER) in lbs per MMBtu were then generated by dividing 2004 NO_x and SO_2 emissions by the 2004 HI:

$$ER_{NOx} = Emissions_{NOx,2004}/HI_{2004}$$
$$ER_{SO2} = Emissions_{SO2,2004}/HI_{2004}$$

The 2004 NO_x and SO_2 emission rates represent the most current operations of coal-fired EGUs; it was assumed that these emission rates would most appropriately represent coal-fired EGU operations in 2018. Emissions were calculated as follows:

$$Emissions_{NOx,2018} = HI_{2018} \times ER_{NOx}$$
$$Emissions_{SO2,2018} = HI_{2018} \times ER_{SO2}$$

As a final step, projected emissions were reduced by any relevant emission caps or permit limits.

Another unique aspect of the growth analysis conducted for the WRAP EGUs was the identification of future EGUs that would need to be built in order to meet projected electricity demand in 2018. The basis of the projected fuel-specific electricity demand was the EIA's annual energy projections out to the year 2025 (EIA, 2005c). The projected increase in electricity demand between 2002 and 2018 was then assumed to be met (in descending order) by the following sources of available generation:

- Unused capacity at existing units (i.e., capacity between existing 2002 generation and capacity factor)
- Units that came on-line in 2003 or 2004
- Units currently under construction
- Units currently being permitted
- Future units

Based upon the available generation from the first four sources of available generation listed above, it was determined that an additional 18 new coal-fired EGUs will be needed to meet projected electricity demand in 2018 in the WRAP region. However, because of excess capacity in natural gas-fired EGUs that are currently under construction or being permitted, it was determined that no additional natural-gas fired EGUs will be needed in 2018. The allocation of the 18 future coal-fired EGUs was based upon state-level capacity (i.e., the sum of existing, under construction, and permitted capacity). County-specific allocation was based upon announcements of planned EGUs (i.e., prior to permitting), as well as the locations of existing EGUs and associated infrastructure.

Methodology Modifications Used to Project Emissions of Point and Area Sources Located Inside Clark County

For Clark County, 2003 point source emissions were provided by DAQEM (see Section 2.0 of this report), while 2002 area source emissions were estimated by ENVIRON (see Section 3.0 of this report). Therefore, the base years for the Clark County projections were 2003 for point sources and 2002 for area sources. ERG used the WRAP methodology to re-calculate all of the Clark County future year emissions. The specific modified steps taken to calculate these projections for point and area sources are described below.

Point Sources (Inside Clark County) – Relevant data fields were extracted from the 2003 base year DAQEM database for all pollutants (i.e., criteria plus NH_3) (DAQEM, 2006). In particular, the data fields were extracted from the following tables:

- EM Table:
  - State/County FIPS
  - State Facility ID
  - Emission Unit ID
  - Process ID
  - Pollutant Code
  - Emission Release Point ID
  - Emission Numeric Value
  - Emission Unit Numerator

- SI Table:
  - Tribal Code
  - Primary SIC
  - Primary NAIC
  - City

- EP Table: SCC

These data fields were then combined into a single base year spreadsheet. A total of 1,189 emission records from the DAQEM database were used as the basis of the point source projections.

The 2003 base year point source emissions were then projected by multiplying base year emissions by the appropriate SCC-specific growth factor for each future year. SCC-specific growth factors were developed using the EGAS (Version 5.0) growth factor model for the state of Nevada for the future years of 2008, 2013, and 2018 (Abt, 2004; U.S. EPA, 2004b). Also, retirement fractions (i.e., estimated percentage of the equipment population retiring each year) were adjusted to account for the 5-, 10-, or 15-year projection period beginning from the 2003 base year.

One key exception to the use of EGAS growth factors is for EGUs, for which the WRAP methodology described above was used. For Clark County, it was assumed that all existing EGUs will reach their individual capacity thresholds by 2008. Instead of projecting these emissions using the EGAS growth factors, the capacity threshold emissions for the existing EGUs were obtained from the WRAP projected emissions for Nevada (ERG, 2006a). These capacity threshold emissions were used for the 2008, 2013, and 2018 projections for all existing EGUs.

For the future year projected emissions, a number of EGUs and cement kilns were added to the inventories. These facilities are either under construction, currently being permitted, or planned for future construction. A description of these facilities is briefly described below:

- Nevada Power – Chuck Lenzie gas-fired EGU: Currently under construction; included in 2008, 2013, and 2018 inventories; emissions from WRAP project (ERG, 2006a).
- Genwest – Silverhawk gas-fired EGU: Currently under construction; included in 2008, 2013, and 2018 inventories; emissions from WRAP project (ERG, 2006a).
- Ivanpah Energy gas-fired EGU: Currently being permitted; included in 2013 and 2018 inventories; emissions from WRAP project (ERG, 2006a).
- Sempra Energy – Copper Mountain gas-fired EGU: Currently being permitted; included in 2013 and 2018 inventories; emissions from WRAP project (ERG, 2006a).
- Calpine gas-fired EGU: Planned; included in 2013 and 2018 inventories; emissions assumed to be the same as Sempra Energy – Copper Mountain (Doyle, 2006b).
- Ashgrove – Moapa cement kiln: Planned; included in 2013 and 2018 inventories; emissions assumed to be the same as Cemex – Lyons (CO) facility from WRAP project (Doyle, 2006b).
- LaFarge cement kiln: Planned; included in 2013 and 2018 inventories; emissions assumed to be the same as Cemex – Lyons (CO) facility from WRAP project (Doyle, 2006b).

Area Sources (Inside Clark County) – The 2002 base year area source emissions (annual, winter average day, and summer average day) were obtained from an inventory spreadsheet provided by ENVIRON. These emissions included VOC, CO, NO_x, SO_x, PM_{10}, $PM_{2.5}$, NH_3, and 203 hazardous air pollutant (HAP) species. Although HAP pollutants were not estimated for the Clark County point sources, and thus were not projected, the area source HAP emissions were projected forward to the future years.

Because the area source base year was 2002 (instead of 2003 as was the case for the point sources), the future projection years for area sources were 2003, 2008, 2013, and 2018. The growth factors for most area source categories were developed using the EGAS (Version 5.0) growth factor model for the state of Nevada (Abt, 2004; U.S. EPA, 2004b). The same growth factors were used for the annual, winter average day, and summer average day emission projections for a given future year.

Although U.S. EPA has begun to question the underlying assumption that emissions growth (as estimated for purposes of regulatory impact analyses) is proportionately dependent upon economic growth (U.S. EPA, 2006), the current projections guidance continues to recommend EGAS; however, use of local data, if available, is always recommended (Solomon, 2006). Upon examination of the 2002 emissions and preliminary growth factors developed by ERG using the state-level EGAS 5.0 model (described above), it was decided to use a recently available local data source to estimate growth factors for these four significant area source categories: architectural surface coatings, industrial surface coatings, degreasing, and consumer solvents. These local data were obtained from the Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas (UNLV) (CBER, 2006; Schwer, 2006). Like the state-level EGAS growth factors, the CBER data were also based upon economic data from the Policy Insight model from Regional Economic Models, Inc. (REMI). However, CBER's REMI data were NAICS-based (i.e., more up-to-date than the SIC classification), and for Clark County, only (i.e., more locally specific than the state-level EGAS/REMI data) (REMI, 2006). Therefore, the following CBER data were applied to the VOC area source categories in order to estimate growth factors:

- Architectural surface coating – 2 subcategories: Population projections.
- Industrial surface coating – 13 subcategories: Output projections for NAICS 321, 332, 333, 335, 337, 339, 482, sum of 3361-3363, sum of 3364-3369, and overall manufacturing (i.e., sum of 31x, 32x, and 33x).
- Degreasing – 11 subcategories: Output projections for NAICS 332, 333, 334, 337, 339, 811 and sum 3361-3363.
- Consumer solvents – 16 subcategories: Population projections.

A more detailed discussion of the revised growth factors from CBER REMI can be found in a separate technical memorandum (ERG, 2006d).

As with the point sources, projected emissions were estimated by multiplying SCC-specific base year emissions by the appropriate SCC-specific growth factor for each future year. The format of all projected year emissions is the same as the 2002 base year inventory spreadsheet. The spreadsheets were also adjusted to incorporate 2002 and future year Stage II vehicle refueling emissions developed by ENVIRON. Emissions for agricultural burning, wildfires, and prescribed fires were not included in the projection spreadsheets, because DAQEM will be using the estimated WRAP day-specific typical year fire emissions and processing them within SMOKE.

Methodology Modifications Used to Project Emissions of Point and Area Sources Located Outside Clark County

The WRAP 2002 emissions inventory and the WRAP 2018 base case projected inventory were used as the basis of the emissions projections for areas outside Clark County (ERG, 2006a). These data sets provided 2002 and 2018 county-level emissions for the states of AZ, CA, CO, ID, MT, ND, NM, NV (excluding Clark County), OR, UT, WA, and WY, as well as the tribes. Using the 2018 WRAP projection spreadsheets as a template, year-specific growth factors and adjustments were created and used to populate new spreadsheets for the intermediate years of 2003, 2008, and 2013 for all states except CA, ND, and SD. The specific projections methodology modifications are described below.

Point and Area Sources Located Outside Clark County (Excluding California, North Dakota, and South Dakota) – The following steps were used to estimate future year emissions for 2003, 2008, and 2013 for the WRAP states and tribes (excluding CA, ND, and SD):

- EGAS growth factors were generated for 2003, 2008, and 2013 using the EGAS Version 5.0 model (as was done for Clark County) and were input to the yearly spreadsheets (Abt, 2004; U.S. EPA, 2004b).

- Point source oil and gas growth factors were ratioed down to the appropriate year based on the 2018 growth factors (ENVIRON, 2005) taken from the WRAP 2018 base case inventory:

  - 2003: ([2018 Factor – 1] × [1/16]) + 1
  - 2008: ([2018 Factor – 1] × [6/16]) + 1
  - 2013: ([2018 Factor – 1] × [11/16]) + 1

- EIA growth factors were generated for 2003, 2018, and 2013 for area source fuel combustion (i.e., industrial, commercial/institutional, and residential) (EIA, 2005c).

- Growth factors for 2003, 2018, and 2013 for agricultural sources throughout the WRAP domain were calculated using a ratio of the national agricultural acreage for the respective projection year divided by the national agricultural acreage for 2002 (USDA, 2005).

- The WRAP Projection Retirement Rates for the 186 SCC codes in the Retirement and Reduction tables were adjusted for the proper years (i.e., for 2018, Annual Retirement × 16):

  - 2003: Annual Retirement × 1
  - 2008: Annual Retirement × 6
  - 2013: Annual Retirement × 11

- Adjustments were made for existing CAMD EGUs contained in 2018 projections:

  - 2003: NO_x emissions were obtained from CAMD (only NO_x and SO_2 emissions were available in CAMD) (U.S. EPA, 2005b); VOC and CO emissions were extrapolated using the ratio of 2003 heat input divided by 2002 heat input (not always possible due to ambiguous unit IDs); any permit limits from the 2018 projections were eliminated.
  - 2008 and 2013: The emissions were assumed to be the same as 2018 (i.e., capacity thresholds reached for existing EGUs and future EGUs under construction and being permitted begin to come on line).

- Adjustments were made for future EGUs contained in 2018 projections:

  - EGUs currently under construction: Omitted from 2003; included in 2008 and 2013
  - EGUs currently being permitted: Omitted from 2003 and 2008; included in 2013
  - EGUs allocated in future: Omitted from 2003, 2008, and 2013

Point and Area Sources Located in California – Due to difficulties associated with ARB providing their own CA projections for 2003, 2008, and 2013 (i.e., as they had previously done for the WRAP project for 2018), it was decided to develop these projections using linear interpolation for all point and area sources. The linear interpolation was based upon the 2002 emissions inventory and 2018 projections provided by ARB for the WRAP project. Although the 2002 emissions inventory and 2018 projections were both provided by ARB, it was not possible to directly develop SCC-level point source emission projections because the 2002 SCC-level information (i.e., Emission Unit IDs, Process IDs, or Emission Release Point IDs) did not match exactly with the 2018 SCC-level information. To remedy this situation, the SCC-level emissions were first aggregated up to the facility-level and then the 2002 Facility IDs were matched to the 2018 Facility IDs. Because of the large number of the point source records for CA, the linear interpolation was performed using Access, rather than Excel, using the following procedure:

- For each matched Facility ID, projection factors were estimated (by pollutant):
  - 2003: $(Emissions_{2002} + [Emissions_{2018} – Emissions_{2002}] \times [1/16])/Emissions_{2002}$
  - 2008: $(Emissions_{2002} + [Emissions_{2018} – Emissions_{2002}] \times [6/16])/Emissions_{2002}$
  - 2013: $(Emissions_{2002} + [Emissions_{2018} – Emissions_{2002}] \times [11/16])/Emissions_{2002}$
- Facility-level projection factors were applied to all 2002 SCC-level emissions under a particular facility by pollutant (i.e., NO_x, VOC, and CO).
- If a facility was included in the 2002 emissions inventory but was missing from the 2018 projections, then it was not included in the 2003, 2008, and 2013 projected inventories.

Point and Area Sources Located in North Dakota and South Dakota – Because of the physical distance between Clark County and ND and SD, it was determined that potential impacts in Clark County from the ND and SD emission sources would likely be small. Therefore, linear interpolation was applied to the 2002 inventory and 2018 WRAP base case projections to obtain projections for 2003, 2008, and 2013. An exception was for the existing CAMD and future EGUs; for these sources, the approach described above for the EGUs located in the other WRAP states was used.

Point and Area Sources Not Included – Emissions for agricultural burning, wildfires, and prescribed fires are not included in these projection spreadsheets. In addition, projected area source oil and gas emissions are not included in these spreadsheets; these will be submitted separately to DAQEM by ENVIRON. However, projected point source oil and gas emissions are included in these spreadsheets.

PROJECTIONS RESULTS

Summary of Results for Point and Area Sources Located Outside Clark County

The results of the future year projected emissions for point and area sources located outside Clark County are summarized in Tables 4-1 through 4-3. The summarized projected emissions include 2003, 2008, and 2013. The 2002 base year inventory and 2018 projected emissions are also included for comparison purposes. It should be noted that area source oil and natural gas emissions were not projected for 2003. As a result, the 2003 area source emissions presented in Tables 4-1 through 4-3 are underestimated. The underestimate for 2003 emissions is significant for states with considerable oil and gas activity (i.e., CO, MT, ND, NM, UT, and WY); the underestimate is nearly negligible for states with little or no oil and gas activity (i.e., AZ, ID, NV, OR, SD, and WA). In general, the state-level distribution of projected point and area source emissions located outside Clark County for 2003, 2008, and 2013 follows the distribution of emissions in the 2002 base year inventory and the 2018 projected results (i.e., the states with the highest and lowest emissions are the same in all five inventories). A detailed analysis of the projected emissions summarized in Tables 4-1 through 4-3

Summary of Results for Point Sources Located Inside Clark County

The results of the future year projected emissions for point sources located inside Clark County are summarized in Tables 4-4 through 4-7. In general, the point sources included these tables are the same as those presented in Section 2.0. However, there are a few closed facilities, as well as new facilities, included in these tables. These facilities are as follows:

- Closed facilities – not in 2003 (Table 4-4): Tsuda Surface Technologies;
- New facility – added in 2003 (Table 4-4): Kern River – Dry Lake – Apex, Mirant Las Vegas, and Reliant Energy – Bighorn;
- New facility – added in 2008 (Table 4-5): Genwest – Silverhawk, and Nevada Power – Chuck Lenzie; and
- New facility – added in 2013 (Table 4-6) and 2018 (Table 4-7): Ashgrove – Moapa, Calpine, Ivanpah Energy, LaFarge, and Sempra Energy – Copper Mountain.

All facilities are listed in alphabetical order; however, the new sources have been appended at the end of these tables.

Summary of Results for Area Sources Located Inside Clark County

The results of the annual future year projected emissions for area sources located inside Clark County are summarized in Tables 4-8 through 4-11.

In order to match the level of detail of the point source projection tables for inside Clark County (i.e., Tables 4-4 through 4-7), Tables 4-8 through 4-11 only include projected emissions for VOC, NO_x, CO, SO_x, PM_{10}, and NH_3. Projected area source emissions for $PM_{2.5}$ and all of the HAP emission species are contained in Excel spreadsheets that have been provided to Clark County DAQEM. In addition, spreadsheets containing summer and winter daily emissions have also been given to Clark County DAQEM.

Table 4-1. Summary of NO_x emissions for other states.

NO_x – Point (tpy)					
State	**2002**	**2003**	**2008**	**2013**	**2018**
AZ	64,084	68,746	71,301	73,942	77,737
CA	104,435	99,121	102,586	106,050	109,515
CO	117,869	117,546	111,461	111,336	112,153
ID	11,486	11,474	11,865	12,007	13,946
MT	53,415	55,197	60,516	60,809	62,583
ND	87,425	86,016	87,904	87,386	91,895
NM	100,352	94,730	85,929	79,589	74,874
OR	24,959	26,746	28,052	31,232	31,761
SD	20,697	21,888	23,366	24,046	24,726
UT	91,044	88,924	88,092	92,906	96,974
WA	43,631	49,177	45,476	47,555	49,397
WY	117,883	118,084	129,805	128,645	132,591
NV (remainder)	21,431	19,828	23,424	26,278	28,011
Tribes	87,215	87,359	90,023	89,665	92,580

NO_x – Area (tpy)					
State	**2002**	**2003[a]**	**2008**	**2013**	**2018**
AZ	9,049	9,063	10,379	11,562	12,559
CA	114,471	114,674	115,688	116,702	117,717
CO	34,846	11,643	38,445	41,496	44,041
ID	30,318	30,256	34,577	36,822	42,068
MT	12,072	4,229	20,997	28,536	36,053
ND	15,457	10,928	17,584	19,356	21,129
NM	85,576	24,009	120,595	147,893	172,319
OR	14,825	18,403	16,083	18,711	17,027
SD	6,345	6,023	6,669	6,937	7,207
UT	11,335	6,132	15,409	18,845	21,636
WA	18,355	17,973	19,905	21,155	22,746
WY	34,891	14,545	53,419	67,907	79,196
NV (remainder)	3,093	3,007	3,450	3,758	3,965
Tribes	2,932	54	61	69	6,639

[a] Area source oil and natural gas emissions are not included in these totals.

Table 4-2. Summary of VOC emissions for other states.

VOC – Point (tpy)					
State	**2002**	**2003**	**2008**	**2013**	**2018**
AZ	5,464	5,634	6,953	8,152	9,459
CA	54,160	50,920	52,156	53,392	54,632
CO	91,750	70,695	80,265	89,688	98,630
ID	2,113	2,139	2,443	2,725	3,059
MT	7,577	7,771	8,761	9,586	10,446
ND	2,086	2,004	2,126	2,247	2,494
NM	17,574	17,967	20,968	23,303	26,187
OR	27,846	28,110	32,762	36,913	41,344
SD	2,542	2,613	2,913	3,218	3,522
UT	7,482	7,766	9,691	11,659	13,600
WA	18,616	18,698	21,554	24,600	28,013
WY	19,663	20,249	22,761	25,194	28,087
NV (remainder)	1,856	1,825	2,227	2,933	3,275
Tribes	1,710	2,050	2,322	2,551	2,864

VOC – Area (tpy)					
State	**2002**	**2003[a]**	**2008**	**2013**	**2018**
AZ	108,332	110,668	132,691	152,769	171,415
CA	343,778	344,651	349,016	353,381	357,746
CO	124,578	97,752	144,197	159,466	173,092
ID	123,944	125,500	152,444	174,677	194,210
MT	55,104	49,330	59,657	63,367	67,477
ND	69,795	62,527	74,616	78,633	82,651
NM	219,124	52,800	289,114	346,006	399,205
OR	251,802	246,025	281,412	303,418	334,872
SD	42,661	42,830	45,440	47,756	50,072
UT	85,320	51,413	120,407	148,214	173,344
WA	198,283	195,238	219,053	235,476	253,710
WY	140,248	25,000	257,878	352,773	436,885
NV (remainder)	16,764	16,862	20,492	23,381	25,952
Tribes	8,472	1,402	1,667	1,899	18,240

[a] Area source oil and natural gas emissions are not included in these totals.

Table 4-3. Summary of CO emissions for other states.

CO – Point (tpy)					
State	**2002**	**2003**	**2008**	**2013**	**2018**
AZ	15,232	16,052	20,152	26,258	33,242
CA	120,089	100,838	108,490	116,143	123,795
CO	35,951	37,518	41,713	49,411	58,211
ID	23,981	24,298	27,437	30,677	38,019
MT	33,199	34,109	45,133	51,242	62,354
ND	11,944	11,992	12,660	13,329	22,373
NM	36,589	41,051	46,210	50,366	57,506
OR	35,494	35,435	41,146	48,184	53,656
SD	4,700	4,876	5,519	6,186	6,852
UT	51,572	52,748	63,871	81,774	98,373
WA	114,317	117,322	134,628	155,859	187,705
WY	36,361	37,651	43,908	48,139	60,997
NV (remainder)	8,006	7,763	8,287	10,088	14,165
Tribes	6,297	6,551	7,042	7,226	12,988

CO – Area (tpy)					
State	**2002**	**2003[a]**	**2008**	**2013**	**2018**
AZ	49,957	49,754	57,922	64,156	70,097
CA	374,891	375,521	378,670	381,818	384,967
CO	87,628	77,486	92,386	93,552	94,595
ID	34,271	33,172	37,304	39,232	40,971
MT	36,903	34,011	38,790	39,874	41,415
ND	21,970	21,905	21,833	21,720	21,607
NM	37,284	33,629	41,702	44,958	47,997
OR	352,955	333,328	365,795	369,515	380,524
SD	24,249	24,293	24,572	24,843	25,112
UT	42,929	44,008	46,909	47,701	45,962
WA	222,555	213,224	235,423	242,651	252,447
WY	29,292	26,184	31,590	33,092	34,463
NV (remainder)	10,363	9,963	11,575	12,390	13,122
Tribes	283	120	126	134	564

[a] Area source oil and natural gas emissions are not included in these totals.

Table 4-4. 2003 Clark County point source emissions (tpy).

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0026	Aladdin Hotel and Casino	0.35	6.97	3.39	0.03	3.39	
0886	Applied Hardcoatings	6.12					
0256	Bally's Hotel and Casino	4.02	12.21	7.72	0.28	3.9	
0611	Barbary Coast	0.02	0.24	0.20	0.00	0.06	
0756	Bellagio/Boardwalk Hotel and Casino	4.73	29.95	39.03	0.80	8.98	
0897	Berlin Industries	29.15	0.72	0.61		0.05	
0004	BPB Gypsum Blue Diamond	19.82	69.10	77.11	0.97	107.73	
0276	Caesar's Palace Hotel and Casino	1.57	8.20	2.08	1.61	4.13	
0482	Capital Cabinets	14.34					
0323	Catalina Plastic and Coating	14.27	0.22	0.37		0.02	
0003	Chemical Lime and Granite Construction Co.	19.65	1,249.55	724.42	233.3	231.17	
0047	Circus Circus Hotel and Casino	2.57	5.73	7.00	0.15	2.66	
0402	City of Las Vegas (WPCF)	29.7	13.37	31.33	6.38	1.86	0.17
1536	Creel Printing	54.37	2.39	6.32	0.08	0.54	
0652	El Dorado Energy	3.52	130.8	4.69	7.01	54.95	93.06
0609	Excalibur Hotel and Casino	1.53	4.75	4.64	0.09	1.65	
0434	Fitzgeralds	0.27	4.30	3.76	0.06	0.35	
0073	Flamingo Hilton	0.67	4.26	6.87	0.05	3.46	
0076	Four Queens Hotel and Casino	0.23	3.64	0.3	0.00	0.26	
0077	Fremont Hotel	0.10	0.97	1.48	0.01	0.33	
0593	Georgia Pacific	9.983	46.91	177.59	1.13	54.72	
0081	Golden Nugget	0.03	1.72	0.89	0.03	0.41	
0257	Harrah's Las Vegas	0.27	4.40	1.00	0.08	1.81	
0085	Horseshoe Club	0.48	4.41	7.19	0.06	1.81	
0613	Imperial Palace Hotel and Casino	1.92	5.01	6.25	0.08	0.67	
0138	J R Simplot Company	5.17	170.86	2.75	51.12	65.66	
0468	Kern River – Goodsprings	0.00	67.69	3.36	3.01	1.08	
0013	Kinder Morgan, CalNev Pipeline	450.53	0.00	0.07	0.00	0.00	
0603	Las Vegas Club	0.28	4.98	3.54	0.06	0.68	
0329	Las Vegas Cogen	14.22	46.40	12.27	2.07	26.66	21.44
0075	Lasco Bathware	340.02	0.69	0.12		0.02	
0856	Luxor Hotel and Casino	1.10	6.40	9.89	0.12	4.55	
0737	Mandalay Bay Resort and Casino	1.59	29.10	23.70	0.19	4.05	
0825	MGM Grand/New York New York	8.71	32.47	33.82	0.78	20.17	
0282	Mirage/ Treasure Island	5.37	14.94	15.84	0.40	7.22	
0074	Monte Carlo Hotel and Casino	0.24	2.26	3.52	0.02	0.33	
0347	Morgan Adhesive	0.15	1.47	1.23	0.02	0.11	
0114	Nellis Air Force Base	223.37	604.75	1,341.76	76.75	122.39	
0360	Nevada Cogeneration Associates #1	6.70	96.56	30.76	1.68	34.56	36.52
0391	Nevada Cogeneration Associates #2	2.31	107.17	28.23	1.70	42.72	27.23

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
AP49110398/0007	Nevada Power Company (Clark Station)	25.20	3,602.78	287.38	8.31	486.28	
0533	Nevada Power Company (Harry Allen)	0.39	6.67	4.49	0.24	3.50	
AP49110400	Nevada Power Company (Reid-Gardner)	58.20	7,767.2	483.6	1,159.00	725.55	
AP49110399/0008	Nevada Power Company (Sunrise Station)	8.71	696.47	129.33	4.40	99.55	
0423	Nevada Sun Peak Partnerships	1.92	129.70	6.75	0.15	5.34	
0011	PABCO Building Products and Sandia	43.47	183.98	242.81	8.66	83.05	
0749	Paris Hotel and Casino	1.04	4.77	8.07	0.13	2.45	
0155	Plaza Hotel	0.78	8.26	9.80	0.17	1.22	
0395	Republic Dumpco	3.62	25.56	7.65	45.83	186	
15033	Republic Services Sunrise	3.27	2.28	14.25	175.16	0.91	
0086	Riviera Hotel and Casino	0.41	8.94	5.89	0.08	0.55	
0154	Royal Cement	0.55	48.00	3.20	6.39	10.50	1.33
0393	Saguaro Power Company	6.90	87.61	19.05	0.08	5.43	17.19
0133	Sahara Hotel and Casino	0.36	4.89	4.05	0.01	0.06	
AP49110466	Southern California Edison (Mohave)	135.42	18,032.22	1,124.57	37,851.20	3,026.89	
0564	Stratosphere Hotel and Casino	3.95	22.08	24.78	0.49	5.13	
0019	TIMET (Titanium Metals)	1.44	2.83	47.76	0.95	33.93	
0153	Tropicana Hotel and Casino	0.64	6.02	9.30	2.27	2.27	
0859	Universal Urethane	38.48					
0697	Venetian Hotel and Casino	0.77	3.90	0.33	0.02	3.40	
0012	Wells Cargo, Inc.	13.7	6.72	33.41	0.87	40.23	
0610	Westward Ho Hotel and Casino	0.04	0.70	0.34	0.01	0.51	
1590	Kern River - Dry Lake-Apex	0.00	16.18	2.19	0.64	0.23	
1520	Mirant Las Vegas	14.14	76.68	38.17	2.69	38.61	21.20
1550	Reliant Energy - Bighorn	0.59	11.45	12.81	0.37	0.97	5.35
Total		**1,643.44**	**33,551.45**	**5,145.08**	**39,658.25**	**5,577.68**	**223.5**

Table 4-5. 2008 Clark County point source emissions (tpy).

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0026	Aladdin Hotel and Casino	0.40	7.90	3.84	0.03	0.26	
0886	Applied Hardcoatings	8.02					
0256	Bally's Hotel and Casino	4.56	13.85	8.76	0.32	0.30	
0611	Barbary Coast	0.02	0.27	0.23	0.00	0.00	
0756	Bellagio/Boardwalk Hotel and Casino	5.36	33.97	44.26	0.91	0.70	
0897	Berlin Industries	36.98	0.91	0.77		0.06	
0004	BPB Gypsum Blue Diamond	21.73	77.45	90.77	1.05	117.59	
0276	Caesar's Palace Hotel and Casino	1.78	9.30	2.36	1.83	0.32	
0482	Capital Cabinets	17.93					
0323	Catalina Plastic and Coating	18.10	0.28	0.47		0.03	
0003	Chemical Lime and Granite Construction Company	23.17	1,473.56	854.29	275.13	269.94	
0047	Circus Circus Hotel and Casino	2.91	6.50	7.94	0.17	0.21	
0402	City of Las Vegas (WPCF)	34.13	15.20	35.95	7.31	2.11	0.20
1536	Creel Printing	68.98	3.03	8.02	0.10	0.69	
0652	El Dorado Energy	3.65	95.40	4.86	7.30	2.64	92.41
0609	Excalibur Hotel and Casino	1.74	5.39	5.26	0.10	0.13	
0434	Fitzgeralds	0.31	4.88	4.26	0.07	0.03	
0073	Flamingo Hilton	0.76	4.83	7.79	0.06	0.27	
0076	Four Queens Hotel and Casino	0.26	4.13	0.34	0.00	0.02	
0077	Fremont Hotel	0.11	1.10	1.68	0.01	0.03	
0593	Georgia Pacific	11.77	54.76	209.42	1.33	64.37	
0081	Golden Nugget	0.03	1.95	1.01	0.03	0.03	
0257	Harrah's Las Vegas	0.31	4.99	1.13	0.09	0.14	
0085	Horseshoe Club	0.54	5.00	8.15	0.07	0.14	
0613	Imperial Palace Hotel and Casino	2.18	5.68	7.09	0.09	0.05	
0138	J R Simplot Company	0.76	185.81	2.99	55.59	71.41	
0468	Kern River - Goodsprings	0.00	76.77	3.81	3.41	0.06	
0013	Kinder Morgan CalNev Pipe Line	500.37	0.00	0.08	0.00	0.00	
0603	Las Vegas Club	0.32	5.65	4.01	0.07	0.05	
0329	Las Vegas Cogen	36.82	52.52	102.94	17.19	208.36	167.99
0075	Lasco Bathware	445.47	0.90	0.16		0.03	
0856	Luxor Hotel and Casino	1.25	7.26	11.22	0.14	0.35	
0737	Mandalay Bay Resort and Casino	1.80	33.00	26.88	0.22	0.31	
0825	MGM Grand/New York New York	9.88	36.82	38.36	0.88	1.57	
0282	Mirage/ Treasure Island	6.09	16.94	17.96	0.45	0.56	
0074	Monte Carlo Hotel and Casino	0.27	2.56	3.99	0.02	0.03	
0347	Morgan Adhesive	0.19	1.86	1.56	0.03	0.14	
0114	Nellis Air Force Base	241.71	654.11	1,447.73	82.93	95.32	
0360	Nevada Cogeneration Associates #1	7.60	109.51	34.88	1.90	15.81	41.42

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0391	Nevada Cogeneration Associates #2	2.62	121.51	32.00	1.92	16.37	30.88
AP49110398/0007	Nevada Power Company (Clark Station)	25.37	3,927.58	289.35	9.74	85.35	
0533	Nevada Power Company (Harry Allen)	0.36	8.00	5.64	5.41	3.06	
AP49110400	Nevada Power Company (Reid-Gardner)	47.53	8,908.77	504.65	1,758.37	751.91	
AP49110399/0008	Nevada Power Company (Sunrise Station)	2.12	921.37	130.22	4.86	6.53	
0423	Nevada Sun Peak Partnerships	1.93	114.38	6.80	0.15	0.23	
0011	PABCO Building Products and Sandia	48.13	214.32	285.92	9.67	95.82	
0749	Paris Hotel and Casino	1.18	5.41	9.15	0.15	0.19	
0155	Plaza Hotel	0.88	9.37	11.11	0.19	0.09	
0395	Republic Dumpco	3.88	26.80	7.99	45.85	202.02	
15033	Republic Services Sunrise	3.90	2.72	16.98	208.72	1.08	
0086	Riviera Hotel and Casino	0.46	10.14	6.68	0.09	0.04	
0154	Royal Cement	0.69	54.25	4.01	8.00	13.14	1.66
0393	Saguaro Power Company	6.95	77.44	19.18	0.08	1.34	17.31
0133	Sahara Hotel and Casino	0.41	5.55	4.59	0.01	0.00	
AP49110466	Southern California Edison (Mohave)	138.64	12,683.61	1,174.40	8,700.70	2,656.57	
0564	Stratosphere Hotel and Casino	4.48	25.04	28.10	0.56	0.40	
0019	TIMET (Titanium Metals)	1.64	3.13	54.77	1.11	37.98	
0153	Tropicana Hotel and Casino	0.73	6.83	10.55	2.57	0.18	
0859	Universal Urethane	50.41					
0697	Venetian Hotel and Casino	0.87	4.42	0.37	0.02	0.26	
0012	Wells Cargo, Inc.	16.50	8.08	108.53	4.79	12.27	
0610	Westward Ho Hotel and Casino	0.05	0.79	0.39	0.01	0.04	
1590	Kern River - Dry Lake-Apex	0.00	18.35	2.48	0.73	0.01	
1520	Mirant Las Vegas	62.38	193.00	123.48	21.73	270.84	4.81
1550	Reliant Energy – Bighorn	43.51	157.90	141.45	24.40	78.73	154.37
A-1584	Genwest - Silverhawk	1.00	309.60	242.89	22.00	37.24	132.03
	Nevada Power - Chuck Lenzie	43.02	545.38	657.00	4.69	59.44	
Total		**2,027.90**	**31,377.81**	**6,883.93**	**11,295.35**	**5,185.21**	**643.07**

Table 4-6. 2013 Clark County point source emissions (tpy).

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0026	Aladdin Hotel and Casino	0.46	9.06	4.41	0.04	0.30	
0886	Applied Hardcoatings	9.79					
0256	Bally's Hotel and Casino	5.23	15.88	10.04	0.36	0.35	
0611	Barbary Coast	0.03	0.31	0.26	0.00	0.01	
0756	Bellagio/Boardwalk Hotel and Casino	6.15	38.95	50.76	1.04	0.80	
0897	Berlin Industries	45.03	1.11	0.94		0.08	
0004	BPB Gypsum Blue Diamond	23.31	86.75	104.02	1.16	125.57	
0276	Caesar's Palace Hotel and Casino	2.04	10.66	2.71	2.09	0.37	
0482	Capital Cabinets	22.15					
0323	Catalina Plastic and Coating	22.04	0.34	0.57		0.03	
0003	Chemical Lime and Granite Construction Company	26.15	1,690.11	979.84	315.56	309.41	
0047	Circus Circus Hotel and Casino	3.34	7.45	9.10	0.20	0.24	
0402	City of Las Vegas (WPCF)	39.09	17.29	41.15	8.35	2.42	0.22
1536	Creel Printing	83.99	3.69	9.76	0.12	0.83	
0652	El Dorado Energy	3.65	95.40	4.86	7.30	2.64	92.41
0609	Excalibur Hotel and Casino	1.99	6.18	6.03	0.12	0.15	
0434	Fitzgeralds	0.35	5.59	4.89	0.08	0.03	
0073	Flamingo Hilton	0.87	5.54	8.93	0.07	0.31	
0076	Four Queens Hotel and Casino	0.30	4.73	0.39	0.00	0.02	
0077	Fremont Hotel	0.13	1.26	1.92	0.01	0.03	
0593	Georgia Pacific	13.49	62.33	240.09	1.52	73.83	
0081	Golden Nugget	0.04	2.24	1.16	0.04	0.04	
0257	Harrah's Las Vegas	0.35	5.72	1.30	0.10	0.16	
0085	Horseshoe Club	0.62	5.74	9.35	0.08	0.16	
0613	Imperial Palace Hotel and Casino	2.50	6.52	8.13	0.10	0.06	
0138	J R Simplot Company	0.76	197.56	3.18	59.11	75.92	
0468	Kern River - Goodsprings	0.00	88.03	4.37	3.91	0.06	
0013	Kinder Morgan CalNev Pipe Line	544.54	0.00	0.07	0.00	0.00	
0603	Las Vegas Club	0.36	6.48	4.60	0.08	0.06	
0329	Las Vegas Cogen	36.82	52.52	103.28	17.18	210.60	168.28
0075	Lasco Bathware	543.72	1.10	0.19		0.03	
0856	Luxor Hotel and Casino	1.43	8.32	12.86	0.16	0.40	
0737	Mandalay Bay Resort and Casino	2.07	37.84	30.82	0.25	0.36	
0825	MGM Grand/New York New York	11.33	42.23	43.98	1.01	1.79	
0282	Mirage/ Treasure Island	6.98	19.43	20.60	0.52	0.64	
0074	Monte Carlo Hotel and Casino	0.31	2.94	4.58	0.03	0.03	
0347	Morgan Adhesive	0.23	2.27	1.90	0.03	0.17	
0114	Nellis Air Force Base	264.60	715.76	1,580.16	90.64	104.06	
0360	Nevada Cogeneration Associates #1	8.72	125.57	39.99	2.18	20.26	47.49

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0391	Nevada Cogeneration Associates #2	3.00	139.32	36.69	2.19	20.92	35.41
AP49110398/0007	Nevada Power Company (Clark Station)	26.44	3,600.81	301.60	10.03	101.99	
0533	Nevada Power Company (Harry Allen)	0.33	7.47	5.37	5.35	2.98	
AP49110400	Nevada Power Company (Reid-Gardner)	47.53	8,908.77	628.27	1,758.37	864.49	
AP49110399/0008	Nevada Power Company (Sunrise Station)	2.12	916.41	135.73	5.02	6.39	
0423	Nevada Sun Peak Partnerships	2.02	100.37	7.08	0.16	0.21	
0011	PABCO Building Products and Sandia	52.09	243.20	327.52	10.55	107.79	
0749	Paris Hotel and Casino	1.35	6.20	10.50	0.17	0.22	
0155	Plaza Hotel	1.01	10.74	12.75	0.22	0.11	
0395	Republic Dumpco	4.13	28.37	8.50	45.90	214.63	
15033	Republic Services Sunrise	4.52	3.15	19.69	241.98	1.26	
0086	Riviera Hotel and Casino	0.53	11.63	7.66	0.10	0.05	
0154	Royal Cement	0.81	59.70	4.74	9.46	15.54	1.97
0393	Saguaro Power Company	7.22	67.34	19.81	0.03	1.62	18.04
0133	Sahara Hotel and Casino	0.47	6.36	5.27	0.01	0.01	
AP49110466	Southern California Edison (Mohave)	138.64	12,683.61	1,174.40	8,700.70	2,656.57	
0564	Stratosphere Hotel and Casino	5.14	28.72	32.23	0.64	0.46	
0019	TIMET (Titanium Metals)	1.83	3.38	61.53	1.25	42.45	
0153	Tropicana Hotel and Casino	0.83	7.83	12.09	2.95	0.20	
0859	Universal Urethane	61.53					
0697	Venetian Hotel and Casino	1.00	5.07	0.43	0.03	0.30	
0012	Wells Cargo, Inc.	18.68	9.16	122.87	6.07	13.90	
0610	Westward Ho Hotel and Casino	0.05	0.91	0.44	0.01	0.05	
1590	Kern River - Dry Lake-Apex	0.00	21.04	2.85	0.83	0.01	
1520	Mirant Las Vegas	62.38	193.00	123.60	21.73	270.84	4.81
1550	Reliant Energy – Bighorn	43.51	157.90	141.49	24.40	78.73	154.37
A-1584	Genwest - Silverhawk	1.00	309.60	242.89	22.00	37.24	132.03
	Nevada Power - Chuck Lenzie	43.02	545.38	657.00	4.69	59.44	
	Ashgrove-Moapa	128.30	2,178.72	203.81	50.34	516.64	
	Calpine	51.62	886.95	788.40	5.63	71.33	
	Ivanpah Energy	51.62	886.95	788.40	5.63	71.33	
	LaFarge	128.30	2,178.72	203.81	50.34	516.64	
	Sempra Energy - Copper Mountain	51.62	886.95	788.40	5.63	71.33	
Total		2,677.63	38,476.65	10,227.03	11,505.87	6,677.90	655.04

Table 4-7. 2018 Clark County point source emissions (tpy).

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0026	Aladdin Hotel and Casino	0.51	10.12	4.92	0.04	0.34	
0886	Applied Hardcoatings	11.53					
0256	Bally's Hotel and Casino	5.84	17.73	11.21	0.41	0.39	
0611	Barbary Coast	0.03	0.35	0.29	0.00	0.01	
0756	Bellagio/Boardwalk Hotel and Casino	6.87	43.49	56.68	1.16	0.89	
0897	Berlin Industries	52.43	1.29	1.10		0.09	
0004	BPB Gypsum Blue Diamond	24.86	88.44	115.77	1.26	133.44	
0276	Caesar's Palace Hotel and Casino	2.28	11.91	3.02	2.34	0.41	
0482	Capital Cabinets	27.76					
0323	Catalina Plastic and Coating	25.66	0.40	0.67		0.04	
0003	Chemical Lime and Granite Construction Company	26.15	1,881.77	1,090.95	351.34	344.36	
0047	Circus Circus Hotel and Casino	3.73	8.32	10.17	0.22	0.26	
0402	City of Las Vegas (WPCF)	44.43	19.55	46.75	9.48	2.75	0.25
1536	Creel Printing	97.78	4.30	11.37	0.14	0.97	
0652	El Dorado Energy	3.66	95.40	4.86	7.30	2.64	92.41
0609	Excalibur Hotel and Casino	2.22	6.90	6.74	0.13	0.16	
0434	Fitzgeralds	0.39	6.24	5.46	0.09	0.03	
0073	Flamingo Hilton	0.97	6.19	9.98	0.07	0.34	
0076	Four Queens Hotel and Casino	0.33	5.29	0.44	0.00	0.03	
0077	Fremont Hotel	0.15	1.41	2.15	0.01	0.03	
0593	Georgia Pacific	15.02	69.00	267.23	1.69	82.21	
0081	Golden Nugget	0.04	2.50	1.29	0.04	0.04	
0257	Harrah's Las Vegas	0.39	6.39	1.45	0.12	0.18	
0085	Horseshoe Club	0.70	6.40	10.44	0.09	0.18	
0613	Imperial Palace Hotel and Casino	2.79	7.28	9.08	0.12	0.07	
0138	J R Simplot Company	0.76	209.30	3.37	62.62	80.43	
0468	Kern River - Goodsprings	0.00	98.30	4.88	4.37	0.07	
0013	Kinder Morgan CalNev Pipe Line	583.95	0.00	0.08	0.00	0.00	
0603	Las Vegas Club	0.41	7.23	5.14	0.09	0.07	
0329	Las Vegas Cogen	36.82	52.52	101.88	17.16	212.61	167.13
0075	Lasco Bathware	640.43	1.30	0.23		0.04	
0856	Luxor Hotel and Casino	1.60	9.29	14.36	0.17	0.45	
0737	Mandalay Bay Resort and Casino	2.31	42.26	34.42	0.28	0.40	
0825	MGM Grand/New York New York	12.65	47.15	49.11	1.13	2.00	
0282	Mirage/ Treasure Island	7.80	21.70	23.00	0.58	0.72	
0074	Monte Carlo Hotel and Casino	0.35	3.28	5.11	0.03	0.03	
0347	Morgan Adhesive	0.27	2.64	2.21	0.04	0.20	
0114	Nellis Air Force Base	290.20	784.88	1,730.97	99.35	114.00	
0360	Nevada Cogeneration Associates #1	9.73	140.22	44.65	2.43	24.26	53.03

Facility Identifier	Facility Name	VOC	NOx	CO	SOx	PM10	NH3
0391	Nevada Cogeneration Associates #2	3.35	155.56	40.97	2.45	25.00	39.54
AP49110398/0007	Nevada Power Company (Clark Station)	22.25	3,097.05	253.79	8.90	114.02	
0533	Nevada Power Company (Harry Allen)	0.33	7.47	5.37	5.35	2.98	
AP49110400	Nevada Power Company (Reid-Gardner)	47.53	8,908.77	833.94	1,758.37	1,015.65	
AP49110399/0008	Nevada Power Company (Sunrise Station)	2.12	908.77	114.21	4.41	5.54	
0423	Nevada Sun Peak Partnerships	1.70	78.76	5.96	0.13	0.17	
0011	PABCO Building Products and Sandia	55.86	268.98	364.37	11.37	118.57	
0749	Paris Hotel and Casino	1.51	6.93	11.72	0.19	0.24	
0155	Plaza Hotel	1.13	12.00	14.23	0.25	0.12	
0395	Republic Dumpco	4.38	30.09	9.07	45.94	227.24	
15033	Republic Services Sunrise	5.12	3.57	22.31	274.24	1.42	
0086	Riviera Hotel and Casino	0.60	12.98	8.55	0.12	0.05	
0154	Royal Cement	0.92	64.24	5.38	10.74	17.65	2.24
0393	Saguaro Power Company	6.08	52.94	16.67	0.02	1.88	15.18
0133	Sahara Hotel and Casino	0.52	7.10	5.88	0.01	0.01	
AP49110466	Southern California Edison (Mohave)	138.64	12,683.61	1,174.40	8,700.70	2,656.57	
0564	Stratosphere Hotel and Casino	5.74	32.06	35.99	0.71	0.51	
0019	TIMET (Titanium Metals)	2.18	3.59	71.42	1.36	51.39	
0153	Tropicana Hotel and Casino	0.93	8.74	13.51	3.30	0.23	
0859	Universal Urethane	72.48					
0697	Venetian Hotel and Casino	1.12	5.66	0.48	0.03	0.34	
0012	Wells Cargo, Inc.	21.17	10.37	139.25	6.08	15.75	
0610	Westward Ho Hotel and Casino	0.06	1.02	0.49	0.01	0.05	
1590	Kern River - Dry Lake-Apex	0.00	23.50	3.18	0.93	0.02	
1520	Mirant Las Vegas	62.38	193.00	123.74	21.74	270.85	4.81
1550	Reliant Energy - Bighorn	43.51	157.90	141.53	24.40	78.73	154.37
A-1584	Genwest - Silverhawk	1.00	309.60	242.89	22.00	37.24	132.03
	Nevada Power - Chuck Lenzie	43.02	545.38	657.00	4.69	59.44	
	Ashgrove-Moapa	128.30	2,178.72	203.81	50.34	516.64	
	Calpine	51.62	886.95	788.40	5.63	71.33	
	Ivanpah Energy	51.62	886.95	788.40	5.63	71.33	
	LaFarge	128.30	2,178.72	203.81	50.34	516.64	
	Sempra Energy - Copper Mountain	51.62	886.95	788.40	5.63	71.33	
Total		2,900.89	38,328.67	10,780.56	11,590.35	6,954.09	661.00

Table 4-8. 2003 Clark County area source emissions (tpy).

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2102002000	Fuel Combustion - Industrial Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2102004000	Fuel Combustion - Industrial Distillate Oil	4.09	490.73	102.24	1,926.13	40.89	16.36
2102005000	Fuel Combustion - Industrial Residual Oil	0.00	0.00	0.00	0.00	0.00	0.00
2102006000	Fuel Combustion - Industrial Natural Gas	0.18	9.25	2.77	0.02	0.25	0.11
2102007000	Fuel Combustion - Industrial Liquified Petroleum Gas (LPG)	2.29	144.73	24.38	0.00	4.57	0.00
2102011000	Fuel Combustion - Industrial Kerosene	0.01	1.01	0.21	0.23	0.08	0.03
2103002000	Fuel Combustion - Commercial/Institutional Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2103004000	Fuel Combustion - Commercial/Institutional Distillate Oil	0.68	40.13	10.03	170.93	4.01	1.61
2103005000	Fuel Combustion - Commercial/Institutional Residual Oil	0.09	4.44	0.40	28.54	1.06	0.06
2103006000	Fuel Combustion - Commercial/Institutional Natural Gas	22.68	412.33	346.35	2.47	31.34	2.02
2103007000	Fuel Combustion - Commercial/Institutional Liquified Petroleum Gas (LPG)	0.34	16.02	2.17	0.00	0.46	0.00
2103011000	Fuel Combustion - Commercial/Institutional Kerosene	0.01	0.61	0.15	0.15	0.06	0.02
2104002000	Fuel Combustion - Residential Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2104004000	Fuel Combustion - Residential Distillate Oil	0.03	0.86	0.24	4.07	0.02	0.04
2104006000	Fuel Combustion - Residential Natural Gas	39.48	674.76	287.13	4.31	54.56	3.52
2104007000	Fuel Combustion - Residential Liquified Petroleum Gas (LPG)	0.28	13.23	1.80	0.00	0.38	0.00
2104008001	Fuel Combustion - Residential Wood Fireplaces	1,079.90	12.26	1,191.19	1.89	163.16	
2104008030	Fuel Combustion - Residential Wood Catalytic Woodstoves	55.50	10.49	395.46	1.48	60.54	
2104008051	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Non-EPA Certified)	278.79	14.73	1,214.06	2.10	160.96	
2104008052	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Low Emitting)	66.60	20.06	805.15	2.22	82.45	
2104011000	Fuel Combustion - Residential Kerosene	0.00	0.04	0.01	0.01	0.00	0.00
2302050000	Bakeries	280.89					
2310001000	Oil and Gas Transmission	0.00	0.00	0.00	0.00	0.00	0.00
2401002000	Architectural Coatings - Solvent-based	1,126.98					
2401003000	Architectural Coatings - Water-based	994.81					
2401005000	Auto Body Refinishing	237.48	0.00	0.00	0.00	0.00	0.00
2401008000	Traffic Marking	21.49					
2401015000	Industrial Surface Coating - Factory Finished Wood	282.49					
2401020000	Industrial Surface Coating - Furniture	345.40					
2401040000	Industrial Surface Coating - Metal Cans	0.00					
2401050000	Industrial Surface Coating - Misc. Finished Metals	125.40					
2401055000	Industrial Surface Coating - Machinery and Equipment	50.31					
2401060000	Industrial Surface Coating - Appliances	565.38					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2401065000	Industrial Surface Coating - Electronic/Electrical	74.01					
2401070000	Industrial Surface Coating - Motor Vehicles	10.56					
2401080000	Industrial Surface Coating - Marine	36.58					
2401085000	Industrial Surface Coating - Railroad/Other	46.27					
2401090000	Industrial Surface Coating - Misc. Manufacturing	538.64					
2401100000	Industrial Surface Coating - Industrial Maintenance Coatings	683.35					
2401200000	Industrial Surface Coating - Other Special Purpose Coatings	683.35					
2415005000	Degreasing: Solvent Cleanup - Furniture and Fixtures (SIC 25): All Processes	143.55					
2415020000	Degreasing: Solvent Cleanup - Fabricated Metal Products (SIC 34): All Processes	0.00					
2415025000	Degreasing: Solvent Cleanup - Industrial Machinery and Equipment (SIC 35): All Processes	0.14					
2415030000	Degreasing: Solvent Cleanup - Electronic and Other Elec. (SIC 36): All Processes	4.86					
2415035000	Degreasing: Solvent Cleanup - Transportation Equipment (SIC 37): All Processes	15.66					
2415040000	Degreasing: Solvent Cleanup - Instruments and Related Products (SIC 38): All Processes	0.12					
2415045000	Degreasing: Solvent Cleanup - Miscellaneous Manufacturing (SIC 39): All Processes	0.25					
2415230000	Degreasing: Cold Cleaning - Electronic and Other Elec. (SIC 36): Conveyerized Degreasing	11.97					
2415245000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Conveyerized Degreasing	161.64					
2415345000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Cold Cleaning	176.58					
2415360000	Degreasing: Cold Cleaning - Automobile Repair	2,096.33					
2420010000	Dry Cleaning: Commercial/Industrial Cleaners	1,128.65					
2420020000	Dry Cleaning: Coin-operated Cleaners	0.00					
2425000000	Graphic Arts	1,042.05	0.00	0.00	0.00	0.00	0.00
2460110000	Consumer Products - Personal Care Products: Hair Care Products	446.54					
2460130000	Consumer Products - Personal Care Products: Fragrance Products	180.24					
2460150000	Consumer Products - Personal Care Products: Nail Care Products	14.13					
2460190000	Consumer Products - Personal Care Products: Miscellaneous Personal Care Products	55.78					
2460230000	Consumer Products - Household Products: Fabric and Carpet Care Products	19.87					
2460250000	Consumer Products - Household Products: Waxes and	73.64					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
	Polishes						
2460270000	Consumer Products - Household Products: Shoe and Leather Care Products	11.36					
2460290000	Consumer Products - Household Products: Miscellaneous Household Products	53.41					
2460410000	Consumer Products - Automotive Aftermarket Products: Detailing Products	87.68					
2460420000	Consumer Products - Automotive Aftermarket Products: Maintenance and Repair Products	293.08					
2460510000	Consumer Products - Coatings and Related Products: Aerosol Spray Paints	291.52					
2460520000	Consumer Products - Coatings and Related Products: Coating Related Products	18.20					
2460610000	Consumer Products - Adhesives and Sealants: Adhesives	2.50					
2460810000	Consumer Products - FIFRA Related Products: Insecticides	303.07					
2460820000	Consumer Products - FIFRA Related Products: Fungicides and Nematicides	1.17					
2460900000	Consumer Products - Miscellaneous Products (Not Otherwise Covered)	733.44					
2461021000	Cutback Asphalt	59.08					
2461850000	Agricultural Pesticide Use	2.46					
2501060050	Gasoline Distribution: Stage I	380.73					
2501060100	Gasoline Distribution: Stage II	706.29					
2501060201	Gasoline Distribution: Tank Breathing	325.97					
2505030120	Gasoline Distribution: Trucks	24.45					
2610000100	Open Burning: Yard Waste - Leaf Species Unspecified	0.19	0.00	0.75	0.00	0.26	0.00
2610000300	Open Burning: Yard Waste - Weed Species Unspecified (incl Grass)	0.14	0.00	1.11	0.00	0.18	0.00
2610000400	Open Burning: Yard Waste - Brush Species Unspecified	0.21	0.00	1.56	0.00	0.19	0.00
2610030000	Open Burning: Household Waste	0.00					
2620000000	Landfills	50.04					
2630000000	Wastewater Treatment	187.18					
2810030000	Structure Fires	22.45	2.86	122.47		22.04	
2810050000	Vehicle Fires	8.15	1.02	31.84		25.47	
Total		16,789.08	1,869.57	4,541.48	2,144.56	652.95	23.77

Table 4-9. 2008 Clark County area source emissions (tpy).

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2102002000	Fuel Combustion – Industrial Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2102004000	Fuel Combustion – Industrial Distillate Oil	4.15	498.51	103.86	1,956.67	41.54	16.62
2102005000	Fuel Combustion – Industrial Residual Oil	0.00	0.00	0.00	0.00	0.00	0.00
2102006000	Fuel Combustion – Industrial Natural Gas	0.21	10.88	3.26	0.02	0.30	0.12
2102007000	Fuel Combustion – Industrial Liquified Petroleum Gas (LPG)	2.44	154.41	26.01	0.00	4.88	0.00
2102011000	Fuel Combustion – Industrial Kerosene	0.01	1.27	0.26	0.29	0.11	0.04
2103002000	Fuel Combustion - Commercial/Institutional Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2103004000	Fuel Combustion - Commercial/Institutional Distillate Oil	0.72	42.29	10.57	180.15	4.23	1.69
2103005000	Fuel Combustion - Commercial/Institutional Residual Oil	0.09	4.30	0.39	27.61	1.03	0.06
2103006000	Fuel Combustion - Commercial/Institutional Natural Gas	25.72	467.62	392.80	2.81	35.54	2.29
2103007000	Fuel Combustion - Commercial/Institutional Liquified Petroleum Gas (LPG)	0.41	18.97	2.57	0.00	0.54	0.00
2103011000	Fuel Combustion - Commercial/Institutional Kerosene	0.01	0.66	0.17	0.16	0.07	0.03
2104002000	Fuel Combustion - Residential Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2104004000	Fuel Combustion - Residential Distillate Oil	0.04	0.96	0.27	4.54	0.02	0.04
2104006000	Fuel Combustion - Residential Natural Gas	49.43	844.85	359.51	5.39	68.31	4.40
2104007000	Fuel Combustion - Residential Liquified Petroleum Gas (LPG)	0.36	16.79	2.28	0.00	0.48	0.00
2104008001	Fuel Combustion - Residential Wood Fireplaces	1,180.70	13.41	1,302.38	2.06	178.39	
2104008030	Fuel Combustion - Residential Wood Catalytic Woodstoves	60.68	11.47	432.38	1.62	66.19	
2104008051	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Non-EPA Certified)	304.82	16.10	1,327.39	2.30	175.99	
2104008052	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Low Emitting)	72.82	21.94	880.30	2.43	90.15	
2104011000	Fuel Combustion - Residential Kerosene	0.00	0.07	0.02	0.02	0.00	0.00
2302050000	Bakeries	308.98					
2310001000	Oil and Gas Transmission	0.00	0.00	0.00	0.00	0.00	0.00
2401002000	Architectural Coatings - Solvent-based	1,427.98					
2401003000	Architectural Coatings - Water-based	1,260.51					
2401005000	Auto Body Refinishing	271.56	0.00	0.00	0.00	0.00	0.00
2401008000	Traffic Marking	24.08					
2401015000	Industrial Surface Coating - Factory Finished Wood	390.75					
2401020000	Industrial Surface Coating - Furniture	457.96					
2401040000	Industrial Surface Coating - Metal Cans	0.00					
2401050000	Industrial Surface Coating - Misc. Finished Metals	170.94					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2401055000	Industrial Surface Coating - Machinery and Equipment	64.09					
2401060000	Industrial Surface Coating - Appliances	721.53					
2401065000	Industrial Surface Coating - Electronic/Electrical	94.45					
2401070000	Industrial Surface Coating - Motor Vehicles	13.58					
2401080000	Industrial Surface Coating - Marine	41.71					
2401085000	Industrial Surface Coating - Railroad/Other	58.84					
2401090000	Industrial Surface Coating - Misc. Manufacturing	664.11					
2401100000	Industrial Surface Coating - Industrial Maintenance Coatings	912.35					
2401200000	Industrial Surface Coating - Other Special Purpose Coatings	912.35					
2415005000	Degreasing: Solvent Cleanup - Furniture and Fixtures (SIC 25): All Processes	190.34					
2415020000	Degreasing: Solvent Cleanup - Fabricated Metal Products (SIC 34): All Processes	0.000					
2415025000	Degreasing: Solvent Cleanup - Industrial Machinery and Equipment (SIC 35): All Processes	0.17					
2415030000	Degreasing: Solvent Cleanup - Electronic and Other Elec. (SIC 36): All Processes	11.15					
2415035000	Degreasing: Solvent Cleanup - Transportation Equipment (SIC 37): All Processes	20.14					
2415040000	Degreasing: Solvent Cleanup - Instruments and Related Products (SIC 38): All Processes	0.28					
2415045000	Degreasing: Solvent Cleanup - Miscellaneous Manufacturing (SIC 39): All Processes	0.31					
2415230000	Degreasing: Cold Cleaning - Electronic and Other Elec. (SIC 36): Conveyerized Degreasing	27.47					
2415245000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Conveyerized Degreasing	199.29					
2415345000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Cold Cleaning	217.71					
2415360000	Degreasing: Cold Cleaning - Automobile Repair	2,781.45					
2420010000	Dry Cleaning: Commercial/Industrial Cleaners	1,259.03					
2420020000	Dry Cleaning: Coin-operated Cleaners	0.00					
2425000000	Graphic Arts	1,179.23	0.00	0.00	0.00	0.00	0.00
2460110000	Consumer Products - Personal Care Products: Hair Care Products	565.81					
2460130000	Consumer Products - Personal Care Products: Fragrance Products	228.38					
2460150000	Consumer Products - Personal Care Products: Nail Care Products	17.91					
2460190000	Consumer Products - Personal Care Products:	70.68					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
	Miscellaneous Personal Care Products						
2460230000	Consumer Products - Household Products: Fabric and Carpet Care Products	25.17					
2460250000	Consumer Products - Household Products: Waxes and Polishes	93.30					
2460270000	Consumer Products - Household Products: Shoe and Leather Care Products	14.39					
2460290000	Consumer Products - Household Products: Miscellaneous Household Products	67.67					
2460410000	Consumer Products - Automotive Aftermarket Products: Detailing Products	111.09					
2460420000	Consumer Products - Automotive Aftermarket Products: Maintenance and Repair Products	371.36					
2460510000	Consumer Products - Coatings and Related Products: Aerosol Spray Paints	369.38					
2460520000	Consumer Products - Coatings and Related Products: Coating Related Products	23.06					
2460610000	Consumer Products - Adhesives and Sealants: Adhesives	3.16					
2460810000	Consumer Products - FIFRA Related Products: Insecticides	384.01					
2460820000	Consumer Products - FIFRA Related Products: Fungicides and Nematicides	1.48					
2460900000	Consumer Products - Miscellaneous Products (Not Otherwise Covered)	929.33					
2461021000	Cutback Asphalt	72.07					
2461850000	Agricultural Pesticide Use	2.87					
2501060050	Gasoline Distribution: Stage I	426.72					
2501060100	Gasoline Distribution: Stage II	511.18					
2501060201	Gasoline Distribution: Tank Breathing	365.34					
2505030120	Gasoline Distribution: Trucks	27.40					
2610000100	Open Burning: Yard Waste - Leaf Species Unspecified	0.23	0.00	0.92	0.00	0.31	0.00
2610000300	Open Burning: Yard Waste - Weed Species Unspecified (incl Grass)	0.17	0.00	1.35	0.00	0.22	0.00
2610000400	Open Burning: Yard Waste - Brush Species Unspecified	0.26	0.00	1.89	0.00	0.23	0.00
2610030000	Open Burning: Household Waste	0.00					
2620000000	Landfills	57.50					
2630000000	Wastewater Treatment	215.09					
2810030000	Structure Fires	28.55	3.63	155.74		28.03	
2810050000	Vehicle Fires	9.92	1.24	38.73		30.99	
Total		20,378.41	2,129.36	5,043.04	2,186.08	727.54	25.31

Table 4-10. 2013 Clark County area source emissions (tpy).

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2102002000	Fuel Combustion - Industrial Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2102004000	Fuel Combustion - Industrial Distillate Oil	4.42	530.36	110.49	2,081.65	44.20	17.68
2102005000	Fuel Combustion - Industrial Residual Oil	0.00	0.00	0.00	0.00	0.00	0.00
2102006000	Fuel Combustion - Industrial Natural Gas	0.23	11.82	3.54	0.03	0.32	0.14
2102007000	Fuel Combustion - Industrial Liquified Petroleum Gas (LPG)	2.58	163.32	27.51	0.00	5.16	0.00
2102011000	Fuel Combustion - Industrial Kerosene	0.01	1.56	0.33	0.36	0.13	0.05
2103002000	Fuel Combustion - Commercial/Institutional Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2103004000	Fuel Combustion - Commercial/Institutional Distillate Oil	0.74	43.55	10.89	185.51	4.35	1.74
2103005000	Fuel Combustion - Commercial/Institutional Residual Oil	0.09	4.32	0.39	27.75	1.03	0.06
2103006000	Fuel Combustion - Commercial/Institutional Natural Gas	29.49	536.24	450.44	3.22	40.75	2.63
2103007000	Fuel Combustion - Commercial/Institutional Liquified Petroleum Gas (LPG)	0.41	19.26	2.61	0.00	0.55	0.00
2103011000	Fuel Combustion - Commercial/Institutional Kerosene	0.01	0.69	0.17	0.17	0.07	0.03
2104002000	Fuel Combustion - Residential Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2104004000	Fuel Combustion - Residential Distillate Oil	0.04	0.90	0.25	4.25	0.02	0.04
2104006000	Fuel Combustion - Residential Natural Gas	55.91	955.56	406.62	6.10	77.26	4.98
2104007000	Fuel Combustion - Residential Liquified Petroleum Gas (LPG)	0.40	18.77	2.55	0.00	0.54	0.00
2104008001	Fuel Combustion - Residential Wood Fireplaces	1,185.70	13.46	1,307.89	2.07	179.15	
2104008030	Fuel Combustion - Residential Wood Catalytic Woodstoves	60.94	11.51	434.21	1.63	66.47	
2104008051	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Non-EPA Certified)	306.11	16.17	1,333.00	2.31	176.73	
2104008052	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Low Emitting)	73.13	22.03	884.03	2.44	90.53	
2104011000	Fuel Combustion - Residential Kerosene	0.00	0.06	0.02	0.02	0.00	0.00
2302050000	Bakeries	332.39					
2310001000	Oil and Gas Transmission	0.00	0.00	0.00	0.00	0.00	0.00
2401002000	Architectural Coatings - Solvent-based	1,721.25					
2401003000	Architectural Coatings - Water-based	1,519.38					
2401005000	Auto Body Refinishing	313.21	0.00	0.00	0.00	0.00	0.00
2401008000	Traffic Marking	25.79					
2401015000	Industrial Surface Coating - Factory Finished Wood	486.57					
2401020000	Industrial Surface Coating – Furniture	513.47					
2401040000	Industrial Surface Coating - Metal Cans	0.00					
2401050000	Industrial Surface Coating - Misc. Finished Metals	212.11					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2401055000	Industrial Surface Coating - Machinery and Equipment	70.98					
2401060000	Industrial Surface Coating – Appliances	818.46					
2401065000	Industrial Surface Coating - Electronic/Electrical	107.13					
2401070000	Industrial Surface Coating - Motor Vehicles	15.84					
2401080000	Industrial Surface Coating – Marine	43.63					
2401085000	Industrial Surface Coating - Railroad/Other	69.69					
2401090000	Industrial Surface Coating - Misc. Manufacturing	760.62					
2401100000	Industrial Surface Coating - Industrial Maintenance Coatings	1,123.45					
2401200000	Industrial Surface Coating - Other Special Purpose Coatings	1,123.45					
2415005000	Degreasing: Solvent Cleanup - Furniture and Fixtures (SIC 25): All Processes	213.41					
2415020000	Degreasing: Solvent Cleanup - Fabricated Metal Products (SIC 34): All Processes	0.00					
2415025000	Degreasing: Solvent Cleanup - Industrial Machinery and Equipment (SIC 35): All Processes	0.19					
2415030000	Degreasing: Solvent Cleanup - Electronic and Other Elec. (SIC 36): All Processes	21.14					
2415035000	Degreasing: Solvent Cleanup - Transportation Equipment (SIC 37): All Processes	23.49					
2415040000	Degreasing: Solvent Cleanup - Instruments and Related Products (SIC 38): All Processes	0.54					
2415045000	Degreasing: Solvent Cleanup - Miscellaneous Manufacturing (SIC 39): All Processes	0.36					
2415230000	Degreasing: Cold Cleaning - Electronic and Other Elec. (SIC 36): Conveyerized Degreasing	52.07					
2415245000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Conveyerized Degreasing	228.26					
2415345000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Cold Cleaning	249.35					
2415360000	Degreasing: Cold Cleaning - Automobile Repair	3,440.21					
2420010000	Dry Cleaning: Commercial/Industrial Cleaners	1,413.87					
2420020000	Dry Cleaning: Coin-operated Cleaners	0.00					
2425000000	Graphic Arts	1,354.44	0.00	0.00	0.00	0.00	0.00
2460110000	Consumer Products - Personal Care Products: Hair Care Products	682.01					
2460130000	Consumer Products - Personal Care Products: Fragrance Products	275.28					
2460150000	Consumer Products - Personal Care Products: Nail Care Products	21.59					
2460190000	Consumer Products - Personal Care Products:	85.19					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
	Miscellaneous Personal Care Products						
2460230000	Consumer Products - Household Products: Fabric and Carpet Care Products	30.34					
2460250000	Consumer Products - Household Products: Waxes and Polishes	112.46					
2460270000	Consumer Products - Household Products: Shoe and Leather Care Products	17.35					
2460290000	Consumer Products - Household Products: Miscellaneous Household Products	81.57					
2460410000	Consumer Products - Automotive Aftermarket Products: Detailing Products	133.91					
2460420000	Consumer Products - Automotive Aftermarket Products: Maintenance and Repair Products	447.63					
2460510000	Consumer Products - Coatings and Related Products: Aerosol Spray Paints	445.25					
2460520000	Consumer Products - Coatings and Related Products: Coating Related Products	27.80					
2460610000	Consumer Products - Adhesives and Sealants: Adhesives	3.81					
2460810000	Consumer Products - FIFRA Related Products: Insecticides	462.88					
2460820000	Consumer Products - FIFRA Related Products: Fungicides and Nematicides	1.78					
2460900000	Consumer Products - Miscellaneous Products (Not Otherwise Covered)	1,120.18					
2461021000	Cutback Asphalt	84.74					
2461850000	Agricultural Pesticide Use	3.24					
2501060050	Gasoline Distribution: Stage I	457.02					
2501060100	Gasoline Distribution: Stage II	417.97					
2501060201	Gasoline Distribution: Tank Breathing	391.28					
2505030120	Gasoline Distribution: Trucks	29.35					
2610000100	Open Burning: Yard Waste - Leaf Species Unspecified	0.27	0.00	1.07	0.00	0.36	0.00
2610000300	Open Burning: Yard Waste - Weed Species Unspecified (incl Grass)	0.20	0.00	1.58	0.00	0.26	0.00
2610000400	Open Burning: Yard Waste - Brush Species Unspecified	0.30	0.00	2.22	0.00	0.27	0.00
2610030000	Open Burning: Household Waste	0.00					
2620000000	Landfills	65.86					
2630000000	Wastewater Treatment	246.37					
2810030000	Structure Fires	33.25	4.23	181.35		32.64	
2810050000	Vehicle Fires	11.61	1.45	45.34		36.27	
Total		23,665.42	2,355.26	5,206.50	2,317.50	757.08	27.35

Table 4-11. 2018 Clark County area source emissions (tpy).

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2102002000	Fuel Combustion - Industrial Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2102004000	Fuel Combustion - Industrial Distillate Oil	4.74	568.76	118.49	2,232.37	47.40	18.96
2102005000	Fuel Combustion - Industrial Residual Oil	0.00	0.00	0.00	0.00	0.00	0.00
2102006000	Fuel Combustion - Industrial Natural Gas	0.25	12.63	3.79	0.03	0.34	0.14
2102007000	Fuel Combustion - Industrial Liquified Petroleum Gas (LPG)	3.06	193.70	32.62	0.00	6.12	0.00
2102011000	Fuel Combustion - Industrial Kerosene	0.02	1.82	0.38	0.42	0.15	0.06
2103002000	Fuel Combustion - Commercial/Institutional Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2103004000	Fuel Combustion - Commercial/Institutional Distillate Oil	0.77	45.06	11.27	191.96	4.51	1.80
2103005000	Fuel Combustion - Commercial/Institutional Residual Oil	0.09	4.35	0.40	27.97	1.04	0.06
2103006000	Fuel Combustion - Commercial/Institutional Natural Gas	32.93	598.78	502.98	3.59	45.51	2.93
2103007000	Fuel Combustion - Commercial/Institutional Liquified Petroleum Gas (LPG)	0.42	19.78	2.68	0.00	0.57	0.00
2103011000	Fuel Combustion - Commercial/Institutional Kerosene	0.01	0.70	0.18	0.17	0.07	0.03
2104002000	Fuel Combustion - Residential Bituminous/Subbituminous Coal	0.00	0.00	0.00	0.00	0.00	0.00
2104004000	Fuel Combustion - Residential Distillate Oil	0.03	0.83	0.23	3.91	0.02	0.04
2104006000	Fuel Combustion - Residential Natural Gas	61.52	1,051.51	447.45	6.71	85.02	5.48
2104007000	Fuel Combustion - Residential Liquified Petroleum Gas (LPG)	0.44	20.68	2.81	0.00	0.59	0.00
2104008001	Fuel Combustion - Residential Wood Fireplaces	1,196.08	13.58	1,319.35	2.09	180.72	
2104008030	Fuel Combustion - Residential Wood Catalytic Woodstoves	61.47	11.61	438.01	1.64	67.05	
2104008051	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Non-EPA Certified)	308.79	16.31	1,344.68	2.33	178.28	
2104008052	Fuel Combustion - Residential Wood Non-Catalytic Woodstoves (Low Emitting)	73.77	22.22	891.78	2.46	91.33	
2104011000	Fuel Combustion - Residential Kerosene	0.00	0.06	0.02	0.02	0.00	0.00
2302050000	Bakeries	351.11					
2310001000	Oil and Gas Transmission	0.00	0.00	0.00	0.00	0.00	0.00
2401002000	Architectural Coatings - Solvent-based	1,949.13					
2401003000	Architectural Coatings - Water-based	1,720.54					
2401005000	Auto Body Refinishing	349.99	0.00	0.00	0.00	0.00	0.00
2401008000	Traffic Marking	26.70					
2401015000	Industrial Surface Coating - Factory Finished Wood	538.84					
2401020000	Industrial Surface Coating – Furniture	604.44					
2401040000	Industrial Surface Coating - Metal Cans	0.00					
2401050000	Industrial Surface Coating - Misc. Finished Metals	240.19					
2401055000	Industrial Surface Coating - Machinery and Equipment	86.14					
2401060000	Industrial Surface Coating – Appliances	947.69					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
2401065000	Industrial Surface Coating - Electronic/Electrical	124.05					
2401070000	Industrial Surface Coating - Motor Vehicles	17.60					
2401080000	Industrial Surface Coating – Marine	51.98					
2401085000	Industrial Surface Coating - Railroad/Other	77.12					
2401090000	Industrial Surface Coating - Misc. Manufacturing	894.52					
2401100000	Industrial Surface Coating - Industrial Maintenance Coatings	1,293.15					
2401200000	Industrial Surface Coating - Other Special Purpose Coatings	1,293.15					
2415005000	Degreasing: Solvent Cleanup - Furniture and Fixtures (SIC 25): All Processes	251.22					
2415020000	Degreasing: Solvent Cleanup - Fabricated Metal Products (SIC 34): All Processes	0.00					
2415025000	Degreasing: Solvent Cleanup - Industrial Machinery and Equipment (SIC 35): All Processes	0.23					
2415030000	Degreasing: Solvent Cleanup - Electronic and Other Elec. (SIC 36): All Processes	26.94					
2415035000	Degreasing: Solvent Cleanup - Transportation Equipment (SIC 37): All Processes	26.10					
2415040000	Degreasing: Solvent Cleanup - Instruments and Related Products (SIC 38): All Processes	0.68					
2415045000	Degreasing: Solvent Cleanup - Miscellaneous Manufacturing (SIC 39): All Processes	0.42					
2415230000	Degreasing: Cold Cleaning - Electronic and Other Elec. (SIC 36): Conveyerized Degreasing	66.36					
2415245000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Conveyerized Degreasing	268.44					
2415345000	Degreasing: Cold Cleaning - Miscellaneous Manufacturing (SIC 39): Cold Cleaning	293.25					
2415360000	Degreasing: Cold Cleaning - Automobile Repair	3,741.78					
2420010000	Dry Cleaning: Commercial/Industrial Cleaners	1,609.45					
2420020000	Dry Cleaning: Coin-operated Cleaners	0.00					
2425000000	Graphic Arts	1,588.44	0.00	0.00	0.00	0.00	0.00
2460110000	Consumer Products - Personal Care Products: Hair Care Products	772.30					
2460130000	Consumer Products - Personal Care Products: Fragrance Products	311.73					
2460150000	Consumer Products - Personal Care Products: Nail Care Products	24.45					
2460190000	Consumer Products - Personal Care Products: Miscellaneous Personal Care Products	96.47					
2460230000	Consumer Products - Household Products: Fabric and Carpet Care Products	34.36					
2460250000	Consumer Products - Household Products: Waxes and	127.35					

SCC	Description	VOC	NOx	CO	SOx	PM10	NH3
	Polishes						
2460270000	Consumer Products - Household Products: Shoe and Leather Care Products	19.64					
2460290000	Consumer Products - Household Products: Miscellaneous Household Products	92.37					
2460410000	Consumer Products - Automotive Aftermarket Products: Detailing Products	151.64					
2460420000	Consumer Products - Automotive Aftermarket Products: Maintenance and Repair Products	506.89					
2460510000	Consumer Products - Coatings and Related Products: Aerosol Spray Paints	504.19					
2460520000	Consumer Products - Coatings and Related Products: Coating Related Products	31.48					
2460610000	Consumer Products - Adhesives and Sealants: Adhesives	4.32					
2460810000	Consumer Products - FIFRA Related Products: Insecticides	524.16					
2460820000	Consumer Products - FIFRA Related Products: Fungicides and Nematicides	2.02					
2460900000	Consumer Products - Miscellaneous Products (Not Otherwise Covered)	1,268.49					
2461021000	Cutback Asphalt	96.60					
2461850000	Agricultural Pesticide Use	3.55					
2501060050	Gasoline Distribution: Stage I	473.08					
2501060100	Gasoline Distribution: Stage II	381.90					
2501060201	Gasoline Distribution: Tank Breathing	405.04					
2505030120	Gasoline Distribution: Trucks	30.38					
2610000100	Open Burning: Yard Waste - Leaf Species Unspecified	0.30	0.00	1.22	0.00	0.41	0.00
2610000300	Open Burning: Yard Waste - Weed Species Unspecified (incl Grass)	0.23	0.00	1.79	0.00	0.30	0.00
2610000400	Open Burning: Yard Waste - Brush Species Unspecified	0.34	0.00	2.52	0.00	0.31	0.00
2610030000	Open Burning: Household Waste	0.00					
2620000000	Landfills	74.87					
2630000000	Wastewater Treatment	280.06					
2810030000	Structure Fires	36.47	4.64	198.95		35.81	
2810050000	Vehicle Fires	13.17	1.65	51.45		41.16	
Total		26,451.88	2,588.67	5,373.03	2,475.66	786.69	29.51

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APPENDIX B

Clark County Consumer Products Emission Inventory Report

Final Clark County Consumer and Commercial Products Emissions Inventory

Submitted to Clark County Department of Air Quality and Environmental Management

November 18, 2005

Submitted by

MACTEC

MACTEC Federal Programs, Inc.
560 Herndon Parkway, Suite 200 • Herndon, Virginia 20170
Phone (703) 471-8383 • Fax (703) 481-8296

Final Clark County Consumer and Commercial Products Emissions Inventory

Submitted to

Clark County Department of Air Quality and Environmental Management

500 S. Grand Central Parkway, 1st Floor
Las Vegas, Nevada 89155
702-455-5942

Submitted by

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November 18, 2005

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Section 1.0 Introduction

The Clark County Department of Air Quality and Environmental Management (DAQEM) is responsible for developing inventories of volatile organic compounds (VOC) and other pollutants that contribute to the formation of ozone. The United States Environmental Protection Agency (EPA) first promulgated ozone ambient air quality standards in 1971 and adopted a new 8-hour standard to replace the 1-hour standard in 1997. Consumer products have been identified as a probable significant contributor to the VOC emission inventory in Clark County, Nevada. MACTEC was retained by DAQEM to determine and quantify the emissions of VOC from consumer products sold and used in Clark County. The study is also to identify control and mitigation measures for VOC emissions from consumer products sources. MACTEC's scope of work consists of the following:

- Identification of consumer product source categories based on the California Air Resources Board (CARB) regulatory program for consumer products and other source categories sold and used in the County.
- Develop a survey package to collect source category and product sales and usage information in the County.
- Review CARB's regulatory program for consumer products to identify methods used to estimate sales and activity data of consumer products, estimation and calculation methodologies for VOC emissions and control technologies and measures.
- Quantify the VOC emissions for consumer products from County sales and usage projections.
- Estimate the growth in VOC emissions in future years.
- Consider and determine the effects of tourism and visitors on the sales and usage of consumer products.
- Evaluate the changes in emissions and determine the impacts of weekday and weekend variations in tourism, if any.
- Evaluate and recommend control measures for consumer product VOC emissions in Clark County.

MACTEC used the results of the survey conducted in the County and information from California's consumer products program to estimate emissions of VOC from product source categories identified as being sold and used in the County in 2002 and 2003. The methodology and data used to construct the sales and usage activity data was taken from the surveys conducted in Clark County, surveys conducted in California and emission estimation methods developed by CARB.

Consumer products were defined for purposes of this study as chemically formulated products used by household and institutional consumers including detergents, cleaning compounds, polishes, cosmetics, personal care products, home products, lawn and garden products, aerosol products and automotive specialty products. Surveys were conducted to gather sales, usage and product formulation data for these sector categories within Clark County. The sectors surveyed included:

- Grocery and convenience stores

- Hardware stores
- General merchandise and department stores
- Home improvement stores
- Janitorial supply stores
- Pharmacies
- Hotels
- Military bases

Product information collected from the surveys of these sectors and CARB survey and product formulation data were used to calculate base year and future year emissions in Clark County. Sections 2 through 6 of this report discuss the survey and methodologies used to determine product sales and usage, VOC content and product formulation and effects of tourism and military operations on emissions. Spreadsheets showing daily and annual average emissions for each source category are provided in Sections 7 and 8. Section 9 discusses mitigation and control measures for VOC emissions from consumer products.

Section 2.0 Review of EPA/CARB/NYSDEC Consumer Product Methodologies

EPA and several states including California have developed technical and regulatory programs to estimate and control VOCs from the use of consumer and commercial products. California has aggressively pursued identifying and quantifying sources of consumer products with both the manufacturers and retailers of consumer products in the State using surveys and working with the formulators and product development staff of representative companies and product research groups. The approaches that EPA, California, and New York have used for estimating emissions from the use of consumer and commercial products and summaries of the resulting emissions are documented in this section of the report. Many of the same retail and manufacturing groups that sell consumer products in California are located in Clark County and do business there. Also, California is a neighboring State from which many visitors travel to Las Vegas. As a result, the emissions factors developed for consumer products use in California would be expected to be very similar to emissions factors for Clark County.

EPA Consumer Products Methodologies

Section 183(e) of the 1990 Clean Air Act Amendments (CAAA) required EPA to prepare a Report to Congress to assess the impact of VOC emissions from the use of consumer and commercial products. In order to obtain data necessary to prepare the report, EPA conducted a consumer product survey in 1992 requesting 1990 sales data from all companies that produced or marketed any of the identified consumer and commercial products. Those products, as defined in the CAAA, consisted of the following main categories:

- Personal care products (hair care-26 subcategories, deodorants and antiperspirants, fragrance, powders, nail care, facial and body treatments, oral care, health use, and miscellaneous);
- Household products (hard surface cleaners, laundry, fabric and carpet care, dishwashing, waxes and polishes, air fresheners, shoe and leather care, miscellaneous);
- Automotive aftermarket products (detailing and maintenance and repair);
- Adhesives and sealants (consumer adhesives and sealants);
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)-regulated products (insecticides, fungicides and nematicides, herbicides, antimicrobial agents, and other FIFRA-related);
- Coatings and related products (aerosol spray paints and coating-related products); and
- Miscellaneous products (arts and crafts, nonpesticidal veterinary and pet products, pressurized food products, and office supplies).

EPA compiled data for 245 individual subcategories of consumer and commercial products. Based on the data received, EPA adjusted the results using the estimated market coverage (25 to 100% but generally 90% or more). EPA determined the percent VOC emitted based on information they obtained on biodegradation or other fates (other than being emitted to the air) of VOCs that enter the wastewater stream. Finally, EPA calculated per capita annual emission rates for each of the 245 categories based on a total population of 284 million. EPA also summarized the data for the individual categories to generate per capita annual emission rates for the major categories and subcategories shown above. These emission rates are documented in the EPA report *Emission Inventory Improvement Program: Preferred and Alternative Methods for Estimating Air Emissions*, Volume III, Chapter 5, August 1996. The per capita annual emission rates do not reflect the EPA national VOC emission standards for 25 consumer product categories published as a final rule on September 11, 1998. The per capita emission rates reflect the removal of nonreactive compounds, including acetone. A summary of the per capita annual emission rates for the major categories within the personal care product, household product, adhesives and sealants, and FIFRA-related product groups of consumer and commercial products is provided in Table 2.1.

California Consumer Products Methodologies

Consumer products comprise one of the largest use categories of total organic gases and reactive organic gases in California. Consumer products as defined in the Health and Safety Code are chemically formulated products used by household and institutional consumers, including detergents, cleaning products, cosmetics, sanitizers, automotive products, home, lawn and garden products, and personal care products. Furniture and architectural coatings are not defined as consumer products.

California's consumer products inventory development is based on a compilation of several surveys and EPA's 1990 Report to Congress. Four surveys provided the basis for compilation of the latest inventory. The surveys focused on collecting product information from the thousands of manufacturers of consumer products that are sold in California. These surveys include the 2001 California Air Resources Board (CARB) Consumer and Commercial Products Survey, the 1997 Consumer and Commercial Products Survey, the 1994/1995 Mid-term Measures Survey, and the 1990 EPA report. A survey for calendar year 2003 is currently in progress. CARB compiled data for over 200 individual sub-categories. Data obtained from these surveys have been used to create the most comprehensive inventory on consumer products to date. Data from these surveys were used to construct the CARB 2004 emission inventory for consumer products. The results from each of these surveys were used to update CARB's database to account for increased growth in consumer products market coverage, to develop regulations and control strategies and to update the California SIP.

The methodology to estimate emissions of total organic gases used statewide sales of each product from the survey multiplied by the percent of each compound that is in the total organic gas definition in that product. The percentage of total organic and reactive organic compounds in each product was obtained from speciation data collected during the surveys.

The basis and assumptions CARB used to generate emission inventories of consumer products included the following:

- A down-the-drain factor for hand soaps and laundry detergents applied to emissions.
- Statewide emissions apportioned to each county by the ratio of the county population and the statewide population.
- The number of units of products sold equals the number of units used.
- The entire quantity of organic compound contained in the consumer products inventory is ultimately emitted to the atmosphere, with the exception of those products with down-the-drain factors.

A summary of 1997 sales and emissions of consumer and commercial products based on survey results is provided in Table 2.2.

New York Consumer Products Methodologies

In the late 1980s the New York State Department of Environmental Conservation (DEC) contracted with MACTEC to perform an analysis of regulatory alternatives for controlling VOC emissions from consumer and commercial products in the New York City metropolitan area as well as in the entire state. DEC specifically asked MACTEC to evaluate the following nine categories of consumer and commercial products: adhesives, all purpose cleaners, disinfectants, air fresheners, hair sprays, animal insecticides, other insecticides, insect repellants, and spray paints. The emissions inventory included products sold to retail customers for household use along with products marketed by wholesale distributors for use in commercial or institutional settings such as beauty shops, schools, and hospitals. Development of the inventory involved the use of three approaches: on-site shelf survey, manufacturer and distributor survey, and analysis of market research data. Using these approaches, MACTEC obtained data on annual usage and VOC content for each product category and form (aerosol, liquid, or solid). A summary of the results of the inventory for the New York City metropolitan area are summarized in Table 2.3.

Table 2.1
Summary of EPA Per Capita Emission Rates for Selected Major Categories Of Consumer and Commercial Products (Pre-Federal Emission Standards)

Category	VOC Content Reported (tons/yr)	Adjusted Product Sales (tons/yr)	Adjusted VOC Content (tons/yr)	VOC Emitted (tons/yr)	Per Capita Emissions (lb/yr/person)
Personal Care Products					
Hair Care	178,685.53	752,801.82	189,794.74	184,564.91	1.49
Deodorants and Antiperspirants	31,061.1	62,736.62	31,075.94	31,075.94	0.251
Fragrances	17,880.98	38,811.03	18,822.08	18,665.72	0.151
Powders	3,374.64	102,703.5	3,552.25	3,552.25	0.0286
Nail Care	4,489.98	12,744.33	4,726.29	4,725.94	0.0381
Facial and Body	7,245.2	146,885.0	7,626.52	7,325.39	0.0591
Oral Care	28,134.66	297,080.94	35,504.5	1,775.22	0.0143
Health Use	5,854.98	56,381.44	6,163.13	6,163.13	0.0497
Miscellaneous	42,458.44	841,356.3	49,223.93	29,467.94	0.238
Household Products					
Hard Surface Cleaners	55,449.94	1,168,799.68	59,534.72	22,451.79	0.181
Laundry	58,204.28	5,159,030.39	74,143.96	7,988.92	0.0644
Fabric and Carpet Care	6,148.55	81,954.64	6,236.63	5,326.49	0.043
Dishwashing	26,690.45	1,034,419.8	34,173.77	1,574.14	0.0127
Waxes and Polishes	12,123.9	220,611.58	12,878.47	12,878.47	0.104
Air Fresheners	34,360.44	141,300.1	38,155.8	33,723.56	0.272
Shoe and Leather Care	230.92	1,086.92	302.95	302.95	0.00244
Miscellaneous	48,869.35	159,742.23	55,798.64	13,800.67	0.111
Adhesives and Sealants					
Consumer Adhesives	55,290.96	458,830.69	61,434.4	61,434.4	0.495
Sealants	8,108.4	199,965.67	9,009.33	9,009.33	0.0727
FIFRA-Regulated Products					
Insecticides	53,592.29	286,284.39	59,216.41	59,216.41	0.478
Fungicides and Nematicides	39,345.83	169,522.4	41,985.84	41,985.84	0.339
Herbicides	63,730.28	440,664.34	63,767.92	63,410.28	0.511
Antimicrobial Agents	33,700.1	457,349.5	34,271.11	17,916.74	0.144
Other FIFRA-Regulated Products	37,810.47	57,811.67	37,890.79	37,890.79	0.306

Table 2.2

1997 Consumer and Commercial Products Survey
Summary of Sales and Emissions (as of 3/21/00)

				Adjusted Emissions*								
Cat. Code	Category Name	Sales (tpd)	Adjusted** Sales (tpd)	VOC (tpd)	PCBTF (tpd)	MeCl (tpd)	TCA (tpd)	VMS (tpd)	Acetone (tpd)	CO2 (tpd)	HFC-152a (tpd)	PERC (tpd)
1101	Arts and Crafts Adhesives	0.10	0.11	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1102	Automotive Adhesives	0.83	0.91	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1103	Carpet and Tile Adhesives	0.67	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1104	Construction and Panel Adhesives	3.80	4.19	0.99	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00
1105	Contact Adhesive	0.40	0.44	0.26	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
1106	General Purpose Adhesive	8.67	9.54	0.17	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
1107	Aerosol Adhesive (including Industrial)	2.27	2.86	1.80	0.00	0.08	0.00	0.00	0.20	0.00	0.00	0.00
1108	Pipe Cements and Primers	1.60	1.76	1.19	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00
1109	Woodworking Glues	2.84	3.12	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1201	Caulking Compounds	49.01	53.91	1.92	0.00	0.00	0.00	0.46	0.08	0.00	0.00	0.00
1202	Cold Process Roof Cements	30.00	33.01	5.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1203	Wood Fillers	2.34	2.58	0.18	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
2101	Bug and Tar Removers	1.21	2.55	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2102	Carpet and Upholstery Cleaners	22.45	24.69	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2103	Automotive Hard Paste Waxes	1.28	1.41	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2104	Automotive Instant Detailers	1.46	1.61	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2105	Automotive Waxes/Polishes/Sealants/	58.60	64.46	1.63	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
2106	Rubber and Vinyl Protectants	17.25	18.97	1.53	0.00	0.00	0.00	2.42	0.00	0.00	0.00	0.01
2107	Automotive Rubbing or Polishing Com	4.18	4.60	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2108	Tire Cleaners	3.08	3.39	0.34	0.00	0.03	0.00	0.23	0.00	0.00	0.00	0.00
2109	Vinyl and Leather Cleaners	0.34	0.37	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2110	Wheel Cleaners	4.41	4.85	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2201	Battery Cleaners	0.10	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2202	Automotive Brake Cleaners	11.69	12.86	5.61	0.00	0.29	0.10	0.00	2.20	0.43	0.00	4.14
2203	Carburetor, Choke Cleaners	8.87	9.76	6.48	0.00	0.31	0.00	0.00	1.54	0.15	0.00	0.00
2204	Engine Degreasers	9.88	11.85	2.21	0.00	0.02	0.00	0.00	0.00	0.04	0.00	0.08

Table 2.2

1997 Consumer and Commercial Products Survey

Summary of Sales and Emissions (as of 3/21/00)

				Adjusted Emissions*								
Cat. Code	Category Name	Sales (tpd)	Adjusted** Sales (tpd)	VOC (tpd)	PCBT F (tpd)	MeCl (tpd)	TCA (tpd)	VMS (tpd)	Acetone (tpd)	CO2 (tpd)	HFC-152a (tpd)	PERC (tpd)
2205	Solvent Parts Cleaner	3.38	3.72	1.63	0.00	0.02	0.22	0.00	0.01	0.00	0.00	0.00
2206	Tire Sealants and Inflators	3.95	4.34	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
2207	Undercoatings	0.71	**2.40**	0.71	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00
2208	Automotive Windshield Washer Fluids	11.53	**51.21**	8.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3101	Brush Cleaners	0.66	0.73	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
3102	Grafitti Removers	1.18	1.30	0.18	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01
3103	Paint Removers or Strippers	5.49	**17.25**	6.30	0.00	7.62	0.00	0.03	1.01	0.01	0.00	0.01
3104	Paint Thinners	25.85	28.44	26.20	0.01	0.00	0.00	0.00	2.03	0.00	0.00	0.00
3201	Multipurpose Solvents	19.17	21.09	15.08	0.00	0.05	0.05	0.01	3.93	0.01	0.00	0.07
3202	Electronic Cleaner	0.79	0.86	0.19	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01
3203	Adhesive Remover	0.60	0.66	0.34	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.01
4101	Disinfectants	1204.55	1325.01	6.71	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
4102	Sanitizers	482.12	530.33	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4103	Sterilants (not including ethylene oxide	1.95	2.14	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4201	Non-selective Herbicides/Defoliants	1647.96	**2966.33**	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4202	Selective Herbicides/Defoliants	150.55	165.61	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4301	Flea and Tick Insecticide	1.61	1.77	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4302	Flying Insect Insecticide	6.05	6.65	0.70	0.00	0.00	0.09	0.00	0.00	0.00	0.01	0.00
4303	Wasp and Hornet Insecticide	2.24	2.47	1.43	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00
4304	Lawn and Garden Insecticides	286.56	315.22	1.92	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
4305	Crawling Bug Insecticides	74.77	82.25	3.91	0.00	0.00	0.41	0.00	0.00	0.09	0.00	0.00
4306	Insecticide Foggers	2.20	2.42	0.94	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
4401	Insect Repellants	2.91	3.20	2.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4402	Fungicides and Nematicides	57.43	63.18	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5101	Carpet and Upholstery Cleaners	1235.13	1358.65	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5102	Carpet Deodorizers	7.63	8.39	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.2

1997 Consumer and Commercial Products Survey
Summary of Sales and Emissions (as of 3/21/00)

				Adjusted Emissions*								
Cat. Code	Category Name	Sales (tpd)	Adjusted** Sales (tpd)	VOC (tpd)	PCBTF (tpd)	MeCl (tpd)	TCA (tpd)	VMS (tpd)	Acetone (tpd)	CO2 (tpd)	HFC-152a (tpd)	PERC (tpd)
5103	Spot Removers	35.35	38.88	0.71	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
5104	Fabric Protectants	1.58	1.74	0.41	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
5201	Floor Wax Strippers	100.24	180.43	4.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
5202	General Purpose Cleaners	66942.81	73637.09	8.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
5203	General Purpose Degreasers	209.75	230.73	2.31	0.00	0.01	0.00	0.00	0.00	0.01	0.06	0.08
5204	Glass Cleaners	92.66	101.92	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5205	Metal Polishes/Cleansers	4.40	4.84	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5206	Oven Cleaners	11.60	12.76	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5207	Toilet Bowl Cleaners	98.95	108.84	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5208	Tub, Tile and Sink Cleaners	51.57	56.72	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5301	Laundry Prewash	37.89	41.68	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5302	Laundry Starches, Sizings, etc.	27.02	29.73	1.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5401	Dusting Aids	24.89	27.37	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5402	Flexible Floor Wax/Polish	45.61	50.17	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5403	Non-resilient Floor Wax/Polish	1.52	1.67	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5404	Wood Floor Wax/Polish	1.17	1.29	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5405	Furniture Waxes and Polishes	13.12	14.43	2.15	0.00	0.00	0.00	0.05	0.00	0.01	0.00	0.00
5406	Shoe Care Products	2.03	2.23	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
5501	Multi-purpose Lubricant	13.26	14.59	4.66	0.00	0.02	0.00	0.00	0.00	0.16	0.00	0.07
5502	Silicone Based Multi-purpose Lubrican	0.93	1.02	0.84	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.03
5503	Penetrant	1.59	1.74	1.20	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.01
5504	Specialty Lubricant	12.18	13.40	0.37	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5601	Single Phase Aerosols Air Fresheners	0.69	0.75	0.23	0.00	0.00	0.00	0.00	0.20	0.00	0.06	0.00
5602	Dual Phase Aerosol Air Fresheners	13.76	15.14	4.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5603	Dual Purpose Air Freshener/Disinfecta	0.16	0.17	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5604	Liquid/Pump Spray Air Fresheners	41.37	45.51	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 2.2

1997 Consumer and Commercial Products Survey
Summary of Sales and Emissions (as of 3/21/00)

				Adjusted Emissions*								
Cat. Code	Category Name	Sales (tpd)	Adjusted** Sales (tpd)	VOC (tpd)	PCBTF (tpd)	MeCl (tpd)	TCA (tpd)	VMS (tpd)	Acetone (tpd)	CO2 (tpd)	HFC-152a (tpd)	PERC (tpd)
5605	Solid/Gel Air Fresheners	16.57	18.23	2.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5701	Charcoal Lighter Materials	7.34	**15.30**	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5702	Aerosol Cooking Sprays	3.17	3.48	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6101	Underarm Antiperspirants	20.82	22.91	2.30	0.00	0.00	0.00	6.50	0.01	0.00	0.72	0.00
6102	Underarm Deodorants	4.77	5.25	1.47	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
6201	Astringents/Toners	19.44	21.38	2.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6202	Hand and Body Lotions	46.77	51.44	0.30	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00
6301	Personal Fragrance Product (<20% Fr)	10.59	11.64	8.57	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
6302	Personal Fragrance Product (>20% Fr)	0.39	0.43	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6401	Hair Spray	40.52	51.87	40.13	0.00	0.00	0.00	0.03	0.00	0.01	0.89	0.00
6402	Hair Mousses	7.63	8.39	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00
6403	Hair Shines	0.41	0.45	0.22	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00
6404	Hair Styling Gels	21.38	23.51	0.36	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
6501	Nail Polish	1.03	1.13	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6502	Base coats, Undercoats	0.15	0.16	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6503	Nail Polish Removers	2.76	4.06	0.85	0.00	0.00	0.00	0.00	2.25	0.00	0.00	0.00
6601	Rubbing Alcohol	15.47	17.02	10.71	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
6602	Shaving Creams	8.84	9.73	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6603	Shaving Gels	8.18	8.99	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6604	Foot Powders	0.42	0.46	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6605	Personal Hygiene Sprays	0.55	0.60	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals		**73508**	**82152**	**236.02**	**0.01**	**8.53**	**0.93**	**10.20**	**14.17**	**1.25**	**1.84**	**5.42**

* Adjustment Factor is the Difference Between Adjusted Sales and Reported Sales
** All Values are Adjusted Assuming 90 Percent Market Coverage Unless Bolded. Adjustments for Bolded Values are Discussed in Cover

Table 2.3
Estimated Annual VOC Emissions from Usage of Consumer and Commercial Products in New York City

Product Type	User Type	Emissions (tons/year)
Adhesives	Household	Not available
	Commercial	1,270
	Total	1,270
Hairsprays	Household	3,328
	Commercial	3,611
	Total	6,939
All Purpose Cleaners	Household	3,894
	Commercial	655
	Total	4,549
Disinfectants	Household	2,764
	Commercial	647
	Total	3,411
Air Fresheners	Household	866
	Commercial	314
	Total	1,180
Animal Insecticides	Household	5
	Commercial	32
	Total	37
Other Insecticides	Household	413
	Commercial	619
	Total	1,032
Insect Repellants	Household	33
	Commercial	15
	Total	48
Spray Paints	Household	4,481
	Commercial	0
	Total	4,481
Total		**22,947**

Section 3.0 Development of Clark County Specific Data-Retail

This section of the report describes the purpose for surveying companies that sell consumer products to the public and the methodology used to implement the survey, collect the sales data, and analyze the data received.

Survey Background

The objectives of this project among others included:

- Generation of a source category list of consumer products that are sold and used within Clark County
- Development of data collection methods to identify product source categories that are sold and used within Clark County.

The source category list of consumer products sold and/or used in the County was based on California's database of products found in their regulations. Table 3.1 identifies the product source categories considered in this study. This product list was selected based on the relative contribution of emissions from the use of personal care products, cleaners, and general degreasers that likely represent the majority of VOC emissions in Clark County. As shown in Table 2.2, the use of personal care products, automotive aftermarket products, paint removers, insecticides, and solvents, cleaners, and general degreasers represent over 75% of the VOC emissions from consumer product use in California. It is expected that the use of these products also contributes about 75% of the VOC emissions from consumer product use in Clark County.

The development of a database to document the quantity and usage of products identified in Table 3.1 was accomplished through a survey sent to retailers, department stores, convenience stores, grocery stores, and home improvement and janitorial supply companies that would likely sell products identified in Table 3.1. The survey forms, directions and cover letter sent to representative retailers are provided in Appendices A and B.

MACTEC prepared the database of companies from several sources including internet searches by product category, telephone books, corporate websites, product research groups, and observation. In addition, California's database of manufacturers of consumer products sold in the State was obtained to supplement and check the Clark County database. Major national corporations with multiple outlets, e.g., grocery stores, pharmacies, and home improvement and department stores, were identified through their corporate headquarters where possible. In most cases corporate or regional headquarters were located out of State. Convenience stores, janitorial supply and some hardware stores were locally based and managed. The survey was sent to a representative sample of these local stores. The majority of retailers reside in the greater Las Vegas valley but retailers in other populated areas of the County, e.g., Laughlin, were also considered. The database of retailers was generated by type of store and/or product. The database consists of company name, address and city, phone number, point of contact and title, if available. The database was updated and improved on a continuing basis through telephone follow-up.

Table 3.1
Product Source Categories Considered

Category	Includes	Example Products (Not All-Inclusive)
Hair Care	Color, Styling, Mousse, Spray, Conditioner, Bleach/Lightener, Growth Retardant/Inhibitor, Shine, Tonic/Restorer, Shampoo, Lice Removers, Wig Cleaners, Pet Shampoo	• White Rain Pearberry Hair Spray 7 oz. • Sun-In Super Streaks • Sally Hansen Crème Hair Bleach for Face • L'Oreal Hair Color Remover Kit • Revlon Colorstay • Citre Shine Instant Conditioner • St. Ives Hair Repair No Frizz Serum • White Rain Select Effects Leave In Conditioner • L'Oreal Casting Color Spa • Grecian Moustache & Beard Haircolor – Dark Brown • Jergens Naturally Smooth Moisturizer • Vidal Sassoon Polishing Drops • Got2B Glued • L'Oreal Kids Styling Gel • VO5 Mousse • Jheri Redding Straightening Gel • Rusk Being Slick Pomade • Minoxidil • AVO Flea & Tick Shampoo • Thermasilk Heat Activated Shampoo Daily Clarifying • Super Star Fantastic Wig Cleaner • Lice Egg Remover Combing Gel
Nail Care	Coating, Artificial Nail, Wrap, Glue Remover, Polish Thinner, and Drying Enhancer	• Sally Hansen Dries Instantly Base Coat • Sally Hansen Artificial Nail Remover • Revlon Nail Builders – Get Smoother Ridge Filler • Naturistics 60 Second Quick Dry Top Coat • L'Oreal Shock Proof Nail Enamel • Orly Smudge Fixer • Revlon Professional Quick Dry Liquid • Almay Massage & Grow Nail and Cuticle Wax • Nail Experts Liquid Silk Wrap
Body Wipes	Baby Wipes, Anti-bacterial Wipes, Refreshing Body Cloths, Medicated Rectal/Vaginal Pads, Hair Removal Towelette, Hand Cleaner Wipes, Pet Shampoo Wipes	• Pampers Sensitive Touch Wipes, 72 ea. • WetOnes Antibacterial Wipes, Wild Watermelon & Ballistic Berry, 24 ea. • Shower to Shower Refreshing Body Cloths, Island Fresh 30 ea. • Tucks Hemorrhoidal Pads with Witch Hazel, 40 ea. • Petkins Doggy Wipes, pkg. of 6
Personal Foaming Products	Foaming Body Wash, Foaming Bath, Foaming Hand Cleaner, Foaming Face Wash, Anti-bacterial Foam, Pet Foaming Cleanser, Acne Wash Foaming Cleanser	• Dove Essential Nutrients Self-Foaming Cleanser 6.76 oz • Pond's Clear Solutions Deep Pore Foaming Cleanser • Vagisil Foaming Wash Fresh Clean Scent 1.6 oz • Dial Complete Foaming Hand Wash 7.5 oz

Table 3.1
Product Source Categories Considered (continued)

Category	Includes	Example Products (Not All-Inclusive)
Personal Hygiene Products	Feminine Sprays, Antifungal Sprays & Liquids, Foot & Sneaker Sprays, Jock Itch Sprays	• Lotrimin AF Jock Itch Spray Powder 100g • FDS Feminine Deodorant Spray Baby Powder 1.5 oz • Tinactin Antifungal Deodorant Powder Spray 100g
Shaving Gel		• Skintimate Shave Gel Sensitive Skin 7 oz • Edge Active Care Gel Clean 7 oz • King of Shaves AlphaGel Shaving Gel Antibacterial Formula 5.95 oz
Insect Repellant (NON-Aerosol)	Insect Repellents for humans and pets	• 10 Hour The Insect Repellent Pump 2 oz • Deep Woods Off! With Sunscreen • Coppertone-R Bug and Sun • Cutter All Family Insect Repellent Towelettes
Leather Care	Cleaner, Polishes, Conditioners, Saddle Soaps, Ball Glove Oils, Liquid Pine Tar, Dyes, Dressings	• Kiwi Leather Dye, Black • Kiwi Sport Shoe Stuff Rain and Stain • Kiwi Suede and Nubuck Cleaner • Kiwi Outdoor Mink Oil
Footwear Care Product	Cleaners, Oils, Shoe Stretch, Conditioners, Polishes, Odor Control, Saddle Soaps	• Kiwi Sport Athletic Shoe Deodorant and Sanitizing • Kiwi Leather Scuff Cover, Black
Fabric or Leather Waterproofer		• Scotchgard Heavy Duty Water Repellent • Rain X Weather Guard • Kiwi Outdoor Wet Pruf
Fabric Refresher		• Febreze • Lysol Disinfectant Spray Plus Fabric Refresher • Arm & Hammer Vacuum Free Foam Carpet Deodorizer
In-dryer Fabric Care	Dryer Activated Cloths	• Dryel
Wrinkle-Releasing Spray	Wrinkle releasing sprays	• Downy Wrinkle Releaser, 500 mL
Anti-Static Product	Concentrates, Sprays, Floor Finishes	• Static Guard 5.5 oz • Endust for Electronics Anti-Static Cleaning and Dusting
Electronic Cleaner		• 3M 16-101 General Purpose Contact Cleaner • Endust for Electronics Floppy Drive Head Cleaner • Endust for Electronics Wipes, 70 count
Jewelry Cleaner		• Tarn-X Jewelry Cleaner
Toilet or Urinal Cleaner/Deodorizer	Bowl Cleaners, Tank Cleaners, Drop-in Cleaners, Deodorizers	• Vanish Hang-Ins • Lime A Way Toilet Bowl Cleaner • Lysol Cling Toilet Bowl Cleaner
Wood Cleaner	Cleaners, Preservatives, Build-up Removers, Polish	• Orange Glo Wood Care Kit • Mop & Glo Hard Wood Floor Cleaner
Aerosol Coatings	Primers, clear coatings, flat coatings, bumpers, trim, general automotive	• Krylon Interior-Exterior Spray Paint • 3M Rust Fighter Aerosol • ESD Permanent Clear Aerosol Coating

Table 3.1
Product Source Categories Considered (continued)

Category	Includes	Example Products (Not All-Inclusive)
Automotive Products	Auto carpet cleaners, waxes, detailers, rubber, vinyl protection, polishing compounds, tire cleaners, brake and wheel cleaners	• Meguiar's Heavy Duty Carpet & Interior Cleaner • Hot Shine High Gloss Tire Spray • Pinnacle Bodywork Shampoo • Klass High Gloss Sealant Glaze • Four Star Ultimate Detailing Clay
Miscellaneous	Insect abatement products, floor wax stripper, pipe sealant and primers, non-aerosol glass cleaner, multi purpose solvents	• Sparkle Aerosol Glass Cleaner • Pour N Peel Floor Stripper • Cutter Backwoods Aerosol Insect Repellent • Raid Flying Insect Killer • Sure Klean Asphalt & Tar Remover

Survey Distribution

Once MACTEC developed the list of survey recipients, the accompanying cover letter, and the survey forms, a package was sent to each company by regular mail. Several of the companies contacted DAQEM or MACTEC to request additional information. A summary of those contacts is provided in Table 3.2. MACTEC also contacted all remaining companies to which the survey was sent to ensure that the package had been received, to offer to answer any questions, and to determine the recipient's intention regarding providing a response. MACTEC left messages in cases that the contact could not be reached. We answered questions and provided additional information by facsimile. In most cases, the recipients indicated that they would need additional time to respond to the survey, often citing the simultaneous survey being conducted by the California Air Resources Board. In some cases, the package was not received and MACTEC sent another package as directed by the company official contacted. MACTEC later conducted another round of phone calls to each company that had not yet responded to the survey. We again offered to answer any questions and attempted to determine if and when a response would be submitted. A summary of the results of the phone calls made by MACTEC is provided in Table 3.3.

Survey Responses

The survey responses actually received from the companies are summarized in Table 3.4. In some cases, the companies indicated that they did not sell any of the products identified in the survey package. In cases that sales data was supplied, the responses varied with respect to the type and completeness. Some responses were provided only in hard copy form and some were provided electronically in various formats. Some of the responses supplied all requested data including VOC and individual compound content of each product. Others only provided the number of units sold and sizes for each product.

Survey Utility

The usefulness of the survey data is dependent on the number of responses received and the completeness of those responses. The survey response rate was very low in that only five companies provided data. Of those five companies, only two provided sufficiently complete data to be of any use. None of the replying companies provided complete VOC/product composition data, which is necessary for making the VOC emission calculations. MACTEC determined that this data was insufficient to use in any fashion for preparing emissions inventories for Clark County. Therefore, a secondary source of data was considered and obtained. The sales and VOC content data contained in the CARB 2001 Consumer and Commercial Products Survey was chosen based on its completeness and representativeness of the data that would have been collected from the surveys for Clark County. The methodology used to complete the 2002 and 2003 emission inventories is discussed in Section 6.0 of this report.

Table 3.2
Clark County Consumer Products Survey Summary of Inquiries Received

Company/Location	Name	Phone/Fax No.	Date	Comments
Walgreens/Deerfield IL	Bryan Schneider	847.914.2440/ 847.914.2660	10/12/04 and later	Responded to their questions; will provide Excel spreadsheet and names of manufacturers; will likely need until mid December to supply data
Target Corporation/ Minneapolis MN	Jill Gilchrist	612.761.4589/	10/12/04	Indicated that they have no questions at present and will attempt to respond by mid November
Target Corporation/ Minneapolis MN	Shaun Nicholson	612.761.1009/	11/4/04	Answered some questions regarding survey
Longs Drug Stores/ Walnut Creek CA	Alan Pope	925.210.6889/ 925.210.6202	10/14/04	Faxed table missing from survey package; will need additional time
Safeway/Pleasanton CA	Sharon Plouffe	925.226.5097/ 925.226.5030	10/20/04 and later	Faxed table missing from survey package; said survey requests more than CARB survey and may not be able to respond but if able may need three months
Pier 1 Imports/Fort Worth TX	John Weisert	817.252.7863/ 817.252.7349	10/19/04	Do not sell any of the product categories in our table and will respond with that information; their SIC may be misleading
Sam's Club (Wal Mart)/Bentonville AR	Heather Weeks	479.204.8584/ 479.277.5844	10/21/04	Faxed table missing from survey; indicated that more time would be needed
MGM Grand/Las Vegas	Jack Stone	702.891.3049	11/18/04	Told him to provide data on products sold in gift shop as well as cleaning products used; use Excel or survey forms; and return data to DAQEM
Albertsons/Boise ID	Mark Schwartz	208.395.3910	11/29/04 and later	Answered questions on missing table and on who should receive response to survey
Caesar's Entertainment/Las Vegas	Judy Glasgow	702.866.1263	11/30/04	Indicated that the response to the survey should be sent to Harish Agarwal
Treasure Island/Las Vegas	Kirsten Naylor	702.894.7547	12/3/04	Indicated that we would like data on products sold in gift shop as well as cleaning products used; identified the other MGM hotels that received the survey
May Department Stores	Charles Miller	314.342.6459	12/13/04	Asked some questions including whether there is a legal requirement to provide the data
ACE Hardware	John Van Zeyl	630.990.8910	12/17/04	Answered questions earlier for Shirley; Van Zeyl indicated that he is sending the data by Federal Express for delivery on 12/20
Waxie Sanitary Supply	Stacy Hunt Ross	858.292.8111	3/10/05	Answered questions about product type code, products to be included in response, and MSDS; will provide data next week

Table 3.3
Summary of Phone Call Results

Company	POC	Location	Date Called: December 2004	Date Called: February 25, 2005	Date Called: March 4, 2005
Sam's Club	Pam Spies	Bentonville, AR	Heather Weeks called-needs more time; faxed table	forwarded package to someone else - unknown	Heather is too busy with the mandatory CA VOC study
7-Eleven	Marlo Michalek	Dallas, TX	Left detailed voice mail message	Left detailed voice mail message	Left detailed voice mail message
Target	Kristen Knowles	Minneapolis, MN	Shaun Nicholson called-had questions	do not participate in surveys	
Kmart	Paul Guyardo	Troy, MI	Left detailed message with Gail	Left detailed voice mail message	Left detailed voice mail message
Vons	Jerry Scorsatto	Arcadia, CA	Forwarded to Sharon Plouffe at corporate	Left detailed voice mail message	Sharon Plouffe doesn't have time
Smith's	Dirk Burningham	Salt Lake City, UT	Left detailed voice mail message-Dick & Carma Howard	Left detailed voice mail message	Left detailed voice mail message
Safeway	Brian C. Cornell	Pleasanton, CA	Sharon Plouffe called-may not respond; needs more time	Left detailed voice mail message	Sharon Plouffe doesn't have time
Kroger	Evan Anthony	Cincinnati, OH	Do business in Clark County only as Smith's Food & Drug	Left detailed voice mail message	
Food 4 Less	Eddie Vasquez	Compton, CA	Will supply data by end of December		
Raley's	Kathy Herbold	W. Sacramento, CA	Have no stores in County-sold to Smith's 3 years ago		

Table 3.3
Summary of Phone Call Results (continued)

Company	POC	Location	Date Called: December 2004	Date Called: February 25, 2005	Date Called: March 4, 2005
Ross Stores	Janet Kanios	Newark, CA	Moved but package forwarded-provided correct address, etc.		
Ross Stores	Katie Lougnot	Pleasanton, CA	Correct name and address for Ross Stores		
Pier 1 Imports	Mike Foulkes	Ft. Worth, TX	John Weisert called-do not sell any products on list		
Mervyn's	Ms. Lee Walker	Hayward, CA	Left detailed voice mail message	Left detailed voice mail message	Left detailed voice mail message
CVS	Chris Bodine	Woonsocket, RI	Tina Egan of legal dept.said they would consider	NO PHONE #	Tina says it got passed on, says will call back
JC Penney	Nick Bomersbach	Plano, TX	Bomersbach asked questions, said they would get back to us	NO PHONE #	Left detailed voice mail message
Big A Drug Store	Dave Wright	South Gate, CA	No stores in County-suggested Amerisource Bergen contact	Left detailed voice mail message	
Walgreens	Doug Egan	Deerfield, IL	Bryan Schneider called-had questions; needs more time	Left detailed voice mail message	Unable to get through to line
Rite Aid	John Learish	Camp Hill, PA	Michael Yount in legal said they would consider responding	Left detailed voice mail message	Left detailed voice mail message

Table 3.3
Summary of Phone Call Results (continued)

Company	POC	Location	Date Called: December 2004	Date Called: February 25, 2005	Date Called: March 4, 2005
Longs Drugs	Todd Vasos	Walnut Creek, CA	Alan Pope called-needs more time; faxed table	NO PHONE #	Alan had assigned it to someone and thought it had been sent out - he's looking into it
Dillard's	Ken Eaton	Little Rock, AR	Ken Eaton said they would consider	NO PHONE #	Ken's secretary says we have the wrong contact - says to send it to Jim Benson in Phoenix
Home Depot	John Costello	Atlanta, GA	Doug Zacker of com. Relations sent to Dir. Env. Compliance	NO PHONE #	Left detailed voice mail message
Lowe's	Dale Pond	Mooresville, NC	Left detailed voice mail message for Chris Ahern (her)	NO PHONE #	Doesn't remember getting it
Albertson's	Paul T. Gannon	Boise, ID	Mark Schwartz called-had questions but intend to respond		
Quick Stop	DJ Longa	Fremont, CA	Left detailed voice mail message		
Federated Dept.	Janet E. Grove	Cincinnati, OH	Christine Brandt working on survey and will return	No phone #	Left detailed voice mail message, Christine is on vacation until next week
May Department Stores	Mary Morgan	N. Hollywood, CA	Requested that survey package be resent		
Wal-Mart	Robert F. Connolly	Bentonville, AR	Heather Weeks is handling Wal-Mart survey and Sam's Club	NO PHONE #	Heather is too busy with the mandatory CA VOC study

Table 3.3
Summary of Phone Call Results (continued)

Company	POC	Location	Date Called: December 2004	Date Called: February 25, 2005	Date Called: March 4, 2005
ACE Hardware	Lori Bossman	Oakbrook, IL	John Van Zeyl called-sent data by Fed Ex to arrive 12/20		
MGM Grand & NY NY Hotels	Jack Stone	Las Vegas, NV	Jack Stone called-had questions; part of MGM		
Bellagio	Larryl Lamb	Las Vegas, NV	Part of MGM		
Boardwalk Hotel	Joe Benson	Las Vegas, NV	Part of MGM		
Primm Valley Casino Resorts	Frank Scharadin	Jean, NV	Part of MGM		
The Mirage	Lisanne Bogle	Las Vegas, NV	Part of MGM		
TI	Kirstin Naylor	Las Vegas, NV	Part of MGM-Mark Stolarczyk of MGM Mirage to handle all	Left detailed voice mail message	
Caesars Entertainment	Steven N. Rosen	Las Vegas, NV	Was given different person and asked to resend survey		
Caesars Entertainment	Steven J. Lyons	Las Vegas, NV	New name and address for Caesar's Entertainment	Left detailed voice mail message	Says went to Tom Irvin, spoke with him, doesn't know, says will call back
Boyd Gaming	Marianne Boyd Johnson	Las Vegas, NV	Secretary trying to find survey package		
Saks Fifth Avenue	Vicky Forinos	Birmingham, AL	Was given different person and asked to resend survey		

Table 3.3
Summary of Phone Call Results (continued)

Company	POC	Location	Date Called: December 2004	Date Called: February 25, 2005	Date Called: March 4, 2005
Saks Fifth Avenue	Terron Schaefer	New York, NY	New name and address for Sak's Fifth Avenue		
Speedee Mart	NA	Las Vegas, NV	Requested that survey package be resent	Left detailed voice mail message for Mike	Left detailed voice mail message for Mike
Short Line Express	Liz Lutz	Las Vegas, NV	Requested that survey package be resent	SEE WHAT SHE CAN DO	Left detailed voice mail message for Mike
Amerisource Bergen Corp	Fred Stern	Chesterbrook, PA	New name and address for Good Neighbor Pharm.		
MGM Mirage	Mark Stolarczyk	Las Vegas, NV	To respond for all of MGM	Left detailed voice mail message	Remembers survey, thinks someone has it, will call back
Mandalay Resort Group	Darlene Ghirardi	Las Vegas, NV	Did not send survey until 1/4/2005		
Harrah's Corp.	Ginny Shanks	Las Vegas, NV	Did not send survey until 1/4/2005	Left detailed voice mail message	Ginny Shanks secretary says I'm speaking to the wrong person
Woodworker's Emporium	John Henderson	Las Vegas, NV	Do not sell any products on list		
TruServ Corporation	Carol Wentworth	Chicago, IL	Left detailed voice mail message	Left detailed voice mail message	
Advance Janitorial Supplies	NA	Las Vegas, NV	Did not send survey until 2/9/2005		Left detailed message
Shuman & Assoc. Janitorial Supplies	NA	Las Vegas, NV	Did not send survey until 2/9/2005		Phone number no longer in service
Waxie Sanitary Supply	NA	Las Vegas, NV	Did not send survey until 2/9/2005		Do not remember seeing survey; otherwise do not plan on submitting any info

Table 3.4
Survey Responses Received

Company Name & Location	Complete (Y/N)	Data Format	Data Provided	Product/ MSDS Information
Food 4 Less Compton, CA	N	hard copy	Category of product (e.g., hair care); item description; unit size; units sold	None
Albertson's Boise, ID	N	electronic	Category of product; sub-category of product; brand; description of product; unit size of product; sales quantity	None
Amerisource Bergen Corp (Good Neighbor Pharmacy) Chesterbrook, PA	N	hard copy	Category of product; brand name; unit size; unit sales volume	From MSDS: Specific gravity for all products
ACE Hardware Oakbrook, IL	N	electronic	Brand name; item description; size in oz.; units shipped; total sales volume (lb/yr); dispensing form (e.g., liquid); vendor information	CD provided with approximately 200 MSDS's. Reviewed 10 MSDS's at random, and most provide the specific gravity of the product, but no VOC information.
Waxie Sanitary Supply	N	electronic; hard copy	Brand Name; dispensing form; annual sales volume (lb/yr)	CD provides MSDS's of all products on spreadsheet. Only some MSDS's provide VOC information.

Section 4.0 Development of Clark County Specific Data-Tourism/Military

This section of the report describes the purpose for surveying hotels, janitorial services, and military bases that use and perhaps sell consumer products and the methodology used to implement the survey, collect the sales data, and analyze the data received.

Survey Background

The objectives of this project among others included:

- Generation of a source category list of consumer products that are sold and used within Clark County
- Development of data collection methods to identify product source categories that are sold and used within Clark County.

The source category list of consumer products sold and/or used in the County was based on California's database of products found in their regulations. Table 3.1 identifies the product source categories considered in this study. This product list was selected based on the relative contribution of emissions from the use of personal care products, cleaners, and general degreasers that likely represent the majority of VOC emissions in Clark County. As shown in Table 2.2, the use of personal care products, automotive aftermarket products, paint removers, insecticides, and solvents, cleaners, and general degreasers represent over 75% of the VOC emissions from consumer product use in California. It is expected that the use of these products also contributes about 75% of the total VOC emissions from consumer products in Clark County and probably close to 100% of the emissions from consumer products use by visitors.

The development of a database to estimate the quantity and usage of products identified in Table 3.1 was accomplished through a survey sent to major hotels and hotel management groups shown in Table 3.1. The form and content of the survey and cover letter were changed from the survey of retailers to focus on product usage rates and to a lesser degree product sales in gift shops and hotel retail outlets. The survey forms, directions and cover letter sent to representative hotels and hotel management groups are provided in Appendices A and B.

MACTEC prepared the database of hotels from several sources including internet searches, telephone books, corporate websites, Las Vegas Convention and Visitors Authority data and observation. The hotel and tourism database focused primarily on the Las Vegas Valley including the towns of Jean and Laughlin. MACTEC's database was constructed in a spreadsheet and included the name, address, phone number, and point of contact. The database was updated, improved and verified through telephone follow-up. The resulting database is contained in Appendix C.

Survey Distribution

Once MACTEC developed the list of survey recipients, the accompanying cover letter, and the survey forms, a package was sent to each hotel or company by regular mail. Several of the hotels contacted MACTEC to request additional information. A summary of those contacts is provided in Table 3.2. MACTEC also contacted all remaining hotels/companies to which the survey was sent to ensure that the package had been received, to offer to answer any questions, and to determine the recipient's intention regarding providing a response. MACTEC left messages in cases that the contact could not be reached. We answered questions and provided additional information by facsimile. In several cases, the recipients did not understand what information they were being asked to provide so MACTEC made some revisions to the original package sent to the hotels and resent the revised materials to the hotels and janitorial companies. In some cases, the package was not received and MACTEC sent another package as directed by the company official contacted. MACTEC later conducted another round of phone calls to each hotel/company that had not yet responded to the survey. We again offered to answer any questions and attempted to determine if and when a response would be submitted. A summary of the results of the phone calls made by MACTEC is provided in Table 3.3.

Survey Responses

Only one hotel responded to the survey. That response provided data for only toiler bowl cleaner used by the hotel company. In addition, the response seemed to assign all usage to only one of a number of hotels operated by the company and that usage amount seemed sufficient for all their hotels.

Survey Utility

The usefulness of the survey data is dependent on the number of responses received and the completeness of those responses. Because only one questionable response was provided, MACTEC determined that there was insufficient data to use in any fashion for preparing emissions inventories for Clark County. Therefore, a secondary source of data was considered and obtained. The sales and VOC content data contained in the CARB 2001 Consumer and Commercial Products Survey was chosen based on its completeness and representativeness of the data that would have been collected from the surveys for Clark County. The methodology used to complete the 2002 and 2003 emission inventories is discussed in Section 6.0 of this report.

5.0 Analysis of Weekday/Weekend Effects

As discussed in the previous section of this report, the tourist population in Clark County is significant and is expected to add substantially to the usage of and emissions from various consumer products. The 35 million visitors per year in the County contribute additional VOC emissions primarily from the use of personal care products such as hairspray and other hair care products. MACTEC obtained statistical information on visitor and tourism characteristics including length of stay, occupancy rates for weekday and weekend and annual occupancy rates from the Las Vegas Convention and Visitors Authority. We analyzed the data to determine if significant differences occurred in occupancy rates and length of stay from the weekdays defined as Monday through Thursday to the weekend defined as Friday through Sunday. Significant differences in visitor counts between the two time periods could result in significant emission variations from weekdays to weekends.

The results for calendar year 2003 as follows:

- Weekend occupancy rate - 92.8%
- Midweek occupancy rate - 81.6%
- Average nights stayed - 3.6

On the basis of occupancy rate, there is a clear increase in the number of visitors during the weekend. This increase appears to be at least 13.7%, although it could be greater if the number of persons per room also increases. It is reasonable to assume that the weekend increase in emissions is 13.7% compared to a typical midweek day. This weekend factor is important for constructing daily or hourly emission values for an episodic period.

Section 6.0 Emission Inventory Methodology

This section of the report describes the consumer products that were inventoried for Clark County, the correlation of these categories with CARB's categories, the methodology used to complete the 2002 and 2003 emission inventories for Clark County, and adjustments made for VOC content.

Products Inventoried/Correlation of Categories

As discussed in Section 3.0, the source category list of consumer products that MACTEC inventoried was based on California's database of products found in their regulations. Table 3.1 identifies the product source categories that were considered in this study. This product list was selected based on the relative contribution of emissions from the use of personal care products, cleaners, and general degreasers that likely represent the majority of VOC emissions in Clark County. As shown in Table 2.2, the use of personal care products, automotive aftermarket products, paint removers, insecticides, and solvents, cleaners, and general degreasers represent over 75% of the VOC emissions from consumer product use in California. It is expected that the use of these products also contributes about 75% of the VOC emissions from consumer product use in Clark County.

Methodology

Due to the small number of surveys returned with usable data (2 total), MACTEC was not able to use the survey data to develop VOC emissions data for Clark County. Therefore, a secondary methodology of calculating representative emissions had to be formulated. Using the data contained in the CARB 2001 Consumer and Commercial Products Survey and the population of California in 2001, MACTEC calculated an emission factor in pounds per day per person for each category to be inventoried for Clark County. In addition, the CARB 2004 emission inventory for consumer products was used to estimate population-weighted emission factors for aerosol coatings, automotive products, and miscellaneous categories, e.g., insect sprays, glass cleaners, and other sources found in Clark County that are not included in the 2001 survey results. Using the CARB 2004 data, aerosol coatings and automotive product use was calculated to contribute approximately 2.28 tons/day of VOC in the County. Miscellaneous sources in aggregate accounted for approximately 3.4 tons/day of VOC emissions in the County. These emission factors were then used to calculate the VOC emissions for the permanent residents, military population, and visitors of Clark County for each consumer products category.

The 2002 and 2003 Clark County emission inventories were compiled based on the results of these calculations, including a visitor "bump-up" factor for certain consumer products categories. MACTEC assumed that visitors would have a higher usage rate of certain product categories than permanent residents while in Las Vegas. The "bump-up" factor was applied to the following categories to estimate VOC emissions from product use by visitors:

- Hair styling product: spray
- Shaving gel
- Personal hygiene products
- Shampoo
- Hair styling product: mousse
- Nail polish
- Conditioner

- Hair shine
- Hair styling product: liquid
- Hair styling product: semisolid
- Personal foaming products
- Hair styling product: solid
- Other hair care products

The “bump-up” factor for hair spray was determined based on results from two separate surveys of visitors to the Las Vegas area. MACTEC conducted the surveys at several locations in the area including malls, hotels and other public places such as the marriage bureau office in downtown Las Vegas. The first survey conducted at a local mall and hotel obtained responses from 45 visitors that used hairspray in Las Vegas. For the second survey at the marriage bureau office, MACTEC interviewed 114 additional users of hairspray. For both surveys, MACTEC asked a series of questions to respondents. Only visitors to the County and/or Las Vegas were included in the survey tabulation and analysis. For the surveys, respondents were asked whether they use hairspray and if “yes” whether or not they use hairspray while in Las Vegas, and if “yes” how many times per day they use hairspray.

MACTEC tabulated the results for both survey data sets and calculated bump factors for each data set. For the 45 respondents from the first survey, the “bump-up” factor was determined to be 1.5. For the 114 responses collected at the marriage bureau, the bump factor was calculated to be 1.1. MACTEC combined the results from the two surveys and calculated a weighted average “bump-up” factor of 1.25 additional uses per day per visitor. The “bump-up” factor for all other categories listed above was assumed to be one (1) additional use per day per visitor. All categories of users (permanent residents, military population, visitors, and visitors with the “bump-up factor”) were totaled per source category for the 2002 and 2003 base years and future year inventories. The raw data obtained from the two surveys are presented in Appendix D.

Adjustments for VOC Content

MACTEC did not make adjustments for VOC content for the 2002 or 2003 Clark County emissions inventories. Because of the close proximity of Clark County to California and the high number of visitors to Clark County from California, we concluded that the VOC content of products sold in California is representative of the VOC content of products used and sold in Clark County.

NIF Database

Clark County DAQEM requested that MACTEC place the consumer products inventory into an electronic database format for use in air quality modeling, specifically the National Emissions Inventory (NEI). MACTEC placed the base and projection year inventories documented in this report in the NEI Input Format (NIF). The NIF database for each emissions year incorporates all of the source categories within Tables 7.1, 7.2, 8.1, 8.2, and 8.3. Appendix E contains a listing of each SCC included within the NIF databases, followed by the respective CARB categories assigned to each by MACTEC.

Section 7.0 Base Year 2002 and 2003 VOC Emission Inventories

This section of the report describes the methodology used to complete the 2002 and 2003 emission inventories for Clark County. As discussed in the previous section, MACTEC calculated emissions for permanent residents, the military population, visitors, and visitors with a "bump-up" category. For these calculations, we applied per capita emission factors derived from the results of the 2001 consumer products survey conducted by CARB. These results are shown in Table 7.1 for year 2002 and in Table 7.2 for year 2003.

The additional assumptions used to develop the 2002 and 2003 VOC emission inventories, e.g., average length of stay per visitor, military population, etc., are included at the end of Tables 7.1 and 7.2.

Table 7.1
Base Year 2002 VOC Emission Inventory

Category	***California Emission Factor (lb/day/person)***	**Total VOC Emissions from Permanent Residents of Clark County (lb/day)**	**Total VOC Emissions from Military Population (lb/day)**	**Total VOC Emissions from Visitors to Clark County (lb/day)**	**Total VOC Emissions from Additional Visitor Bump-up (lb/day)**	**Total VOC Emissions for Clark County (lb/day)**	**Total VOC Emissions for Clark County (ton/yr)**
Hair styling product: spray	8.73E-04	1,377.2	12.8	285.1	356.3	**2,031.5**	**370.7**
Automotive maintenance and repair	9.69E-04	1,529.6	14.3			**1,543.9**	**281.8**
Aerosol spray paints	9.64E-04	1,521.8	14.2			**1,536.0**	**280.3**
Insecticides	9.53E-04	1,504.4	14.0			**1,518.4**	**277.1**
Personal fragrance	4.95E-04	780.9	7.3	161.6		**949.8**	**173.3**
Packaged solvent	4.23E-04	667.5	6.2			**673.7**	**123.0**
Automotive detailing products	2.90E-04	457.4	4.3			**461.7**	**84.3**
General purpose degreaser	2.46E-04	389.0	3.6			**392.6**	**71.7**
Waxes and Polishes	2.44E-04	384.4	3.6			**387.9**	**70.8**
Toilet/Urinal Deodorizer	1.30E-04	204.6	1.9	42.3		**248.8**	**45.4**
Shaving gel	6.78E-05	107.0	1.0	22.1	22.1	**152.3**	**27.8**
Adhesive remover	7.62E-05	120.2	1.1			**121.3**	**22.1**
Personal hygiene product	5.14E-05	81.2	0.8	16.8	16.8	**115.5**	**21.1**
Fabric refresher	6.59E-05	103.9	1.0			**104.9**	**19.1**
Aerosol coating related products	6.01E-05	94.8	0.9			**95.7**	**17.5**
Shampoo	3.99E-05	63.0	0.6	13.0	13.0	**89.7**	**16.4**
Multi-purpose remover	5.45E-05	86.0	0.8			**86.8**	**15.8**
Insect Repellent: Non-aerosol	4.93E-05	77.8	0.7			**78.5**	**14.3**
Hair styling product: mousse	3.07E-05	48.5	0.5	10.0	10.0	**69.0**	**12.6**
Nail polish	2.53E-05	40.0	0.4	8.3	8.3	**56.9**	**10.4**
Conditioner	2.37E-05	37.3	0.3	7.7	7.7	**53.2**	**9.70**
Hair color product: permanent	2.07E-05	32.7	0.3	6.8		**39.7**	**7.25**
Electronic cleaner	2.05E-05	32.4	0.3			**32.7**	**5.97**
Wood cleaner	1.87E-05	29.5	0.3			**29.8**	**5.44**
Solvent parts cleaner: non-aerosol	1.74E-05	27.4	0.3			**27.7**	**5.05**
Footwear care product	1.43E-05	22.5	0.2	4.7		**27.4**	**4.99**
Toilet/Urinal Cleaner & Deodorizer	1.40E-05	22.1	0.2	4.6		**26.9**	**4.90**
Anti-static product	1.31E-05	20.7	0.2	4.3		**25.2**	**4.59**
Hair shine	1.04E-05	16.4	0.2	3.4	3.4	**23.3**	**4.25**
Fabric or leather waterproofer	1.18E-05	18.6	0.2			**18.8**	**3.43**
Body wipes	9.66E-06	15.2	0.1	3.2		**18.5**	**3.38**
Graffiti remover	9.81E-06	15.5	0.1			**15.6**	**2.85**
Hair styling product: liquid	6.68E-06	10.6	0.1	2.2	2.2	**15.0**	**2.74**
Leather care product	8.60E-06	13.6	0.1			**13.7**	**2.50**
Contact adhesive	8.25E-06	13.0	0.1			**13.1**	**2.40**
Hair styling product: semisolid	4.99E-06	7.9	0.1	1.6	1.6	**11.2**	**2.05**
Hair color product: temporary	5.06E-06	8.0	0.1	1.7		**9.7**	**1.77**
Personal foaming product	3.30E-06	5.2	0.05	1.1	1.1	**7.4**	**1.35**
Fungicides & Nematicides	3.86E-06	6.1	0.1			**6.1**	**1.12**
Toilet or urinal cleaner	2.93E-06	4.6	0.04	1.0		**5.6**	**1.03**
Nail treatment product	2.92E-06	4.6	0.04	1.0		**5.6**	**1.02**
Bleach/lightener	2.75E-06	4.3	0.04	0.9		**5.3**	**0.96**
Nail product: drying enhancer	2.21E-06	3.5	0.03	0.7		**4.2**	**0.78**
Top coat	1.80E-06	2.8	0.03	0.6		**3.5**	**0.63**
Base coat/undercoat	1.74E-06	2.7	0.03	0.6		**3.3**	**0.61**
Hair color product: semipermanent	9.57E-07	1.5	0.01	0.3		**1.8**	**0.34**
Hair color product: demipermanent	8.73E-07	1.4	0.01	0.3		**1.7**	**0.31**
Hair tonic/ Hair restorer	6.62E-07	1.0	0.01	0.2		**1.3**	**0.23**
Nail polish thinner	3.73E-07	0.6	0.01	0.1		**0.7**	**0.13**
Hair styling product: solid	9.83E-08	0.2	0.001	0.03	0.03	**0.2**	**0.04**
Artificial nail, wrap, or nail glue remover	6.94E-08	0.1	0.001	0.02		**0.1**	**0.02**
Jewelry cleaner	5.49E-08	0.1	0.001	0.02		**0.1**	**0.02**
Other hair care products	1.73E-08	0.03	0.0003	0.01	0.01	**0.04**	**0.01**
Miscellaneous *	1.54E-03	2,435.8	22.7			**2,458.5**	**448.7**
Emissions Grand Total		**12,457.2**	**116.1**	**606.1**	**442.7**	**13,622.1**	**2,486.0**

Table 7.1
Base Year 2002 VOC Emission Inventory (continued)

Assumptions

Clark County population (2002)	1,578,332
Visitors to Clark County (2002)	35,071,504 /year
Military Population (Permanent)	8,000
Military Population (Training)	350,000 /year
TOTAL Population	37,007,836

Average length of stay/visitor (nights) 3.4
[At 3.4 nights/person; 365 nights/year; 35,071,504 visitors per year = 326,693 visitors/night]

Visitor hairspray bump-up factor	1.25 additional uses per day
Visitor bump-up factor (other categories)	1 additional use per day

Military population/day (approximate) 14,712
[At 7 days/person training; 365 days/yr; plus 8,000 permanent population]

* "Miscellaneous" includes, but is not limited to, glass cleaners, paint remover, multipurpose solvents, sealants, caulking, oven cleaners, and laundry prewash.

Table 7.2
Base Year 2003 VOC Emission Inventory

Category	*California Emission Factor (lb/day/person)*	**Total VOC Emissions from Permanent Residents of Clark County (lb/day)**	**Total VOC Emissions from Military Population (lb/day)**	**Total VOC Emissions from Visitors to Clark County (lb/day)**	**Total VOC Emissions from Additional Visitor Bump-up (lb/day)**	**Total VOC Emissions for Clark County (lb/day)**	**Total VOC Emissions for Clark County (ton/yr)**
Hair styling product: spray	8.73E-04	1,432.4	12.8	288.9	361.1	**2,095.2**	**382.4**
Automotive maintenance & repair	9.69E-04	1,590.9	14.3			**1,605.1**	**292.9**
Aerosol spray paints	9.64E-04	1,582.7	14.2			**1,596.9**	**291.4**
Insecticides	9.53E-04	1,564.7	14.0			**1,578.7**	**288.1**
Personal fragrance	5.19E-04	852.1	7.6	171.8		**1,031.5**	**188.3**
Packaged solvent	4.23E-04	694.2	6.2			**700.4**	**127.8**
Automotive detailing products	2.90E-04	475.7	4.3			**480.0**	**87.6**
General purpose degreaser	2.46E-04	404.6	3.6			**408.2**	**74.5**
Waxes and Polishes	2.44E-04	399.8	3.6			**403.3**	**73.6**
Toilet/Urinal Deodorizer	1.30E-04	212.8	1.9	42.9		**257.6**	**47.0**
Shaving gel	6.78E-05	111.3	1.0	22.4	22.4	**157.2**	**28.7**
Adhesive remover	7.62E-05	125.0	1.1			**126.2**	**23.0**
Personal hygiene product	5.14E-05	84.4	0.8	17.0	17.0	**119.2**	**21.8**
Fabric refresher	6.59E-05	108.1	1.0			**109.1**	**19.9**
Aerosol coating related products	6.01E-05	98.6	0.9			**99.5**	**18.2**
Shampoo	3.99E-05	65.5	0.6	13.2	13.2	**92.6**	**16.9**
Multi-purpose remover	5.45E-05	89.4	0.8			**90.2**	**16.5**
Insect Repellent: Non-aerosol	4.93E-05	80.9	0.7			**81.6**	**14.9**
Hair styling product: mousse	3.07E-05	50.4	0.5	10.2	10.2	**71.2**	**13.0**
Nail polish	2.53E-05	41.6	0.4	8.4	8.4	**58.7**	**10.7**
Conditioner	2.37E-05	38.8	0.3	7.8	7.8	**54.9**	**10.0**
Hair color product: permanent	2.07E-05	34.0	0.3	6.9		**41.1**	**7.51**
Electronic cleaner	2.05E-05	33.7	0.3			**34.0**	**6.21**
Wood cleaner	1.87E-05	30.7	0.3			**31.0**	**5.65**
Solvent parts cleaner: non-aerosol	1.74E-05	28.5	0.3			**28.8**	**5.25**
Footwear care product	1.43E-05	23.4	0.2	4.7		**28.3**	**5.17**
Toilet/Urinal Cleaner & Deodorizer	1.40E-05	23.0	0.2	4.6		**27.8**	**5.08**
Anti-static product	1.31E-05	21.5	0.2	4.3		**26.1**	**4.75**
Hair shine	1.04E-05	17.0	0.2	3.4	3.4	**24.0**	**4.39**
Fabric or leather waterproofer	1.18E-05	19.4	0.2			**19.5**	**3.56**
Body wipes	9.66E-06	15.9	0.1	3.2		**19.2**	**3.50**
Graffiti remover	9.81E-06	16.1	0.1			**16.2**	**2.96**
Hair styling product: liquid	6.68E-06	11.0	0.1	2.2	2.2	**15.5**	**2.83**
Leather care product	8.60E-06	14.1	0.1			**14.2**	**2.60**
Contact adhesive	8.25E-06	13.5	0.1			**13.7**	**2.49**
Hair styling product: semisolid	4.99E-06	8.2	0.1	1.7	1.7	**11.6**	**2.11**
Hair color product: temporary	5.06E-06	8.3	0.1	1.7		**10.1**	**1.83**
Personal foaming product	3.30E-06	5.4	0.05	1.1	1.1	**7.7**	**1.40**
Fungicides & Nematicides	3.86E-06	6.3	0.06			**6.4**	**1.17**
Toilet or urinal cleaner	2.93E-06	4.8	0.04	1.0		**5.8**	**1.06**
Nail treatment product	2.92E-06	4.8	0.04	1.0		**5.8**	**1.06**
Bleach/lightener	2.75E-06	4.5	0.04	0.9		**5.5**	**1.00**
Nail product: drying enhancer	2.21E-06	3.6	0.03	0.7		**4.4**	**0.80**
Top coat	1.80E-06	3.0	0.03	0.6		**3.6**	**0.65**
Base coat/undercoat	1.74E-06	2.9	0.03	0.6		**3.5**	**0.63**
Hair color product: semipermanent	9.57E-07	1.6	0.01	0.3		**1.9**	**0.35**
Hair color product: demipermanent	8.73E-07	1.4	0.01	0.3		**1.7**	**0.32**
Hair tonic/ Hair restorer	6.62E-07	1.1	0.01	0.2		**1.3**	**0.24**
Nail polish thinner	3.73E-07	0.6	0.01	0.1		**0.7**	**0.14**
Hair styling product: solid	9.83E-08	0.2	0.001	0.03	0.03	**0.2**	**0.04**
Artificial nail, wrap, or nail glue remover	6.94E-08	0.1	0.001	0.02		**0.1**	**0.03**
Jewelry cleaner	5.49E-08	0.1	0.001	0.02		**0.1**	**0.02**
Other hair care products	1.73E-08	0.03	0.0003	0.01	0.01	**0.04**	**0.01**
Miscellaneous *	1.54E-03	2,533.3	22.7			**2,556.0**	**466.5**
Emissions Grand Total		**12,995.9**	**116.5**	**622.3**	**448.6**	**14,183.2**	**2,588.4**

Table 7.2
Base Year 2003 VOC Emission Inventory (continued)

Assumptions

Clark County population (2003)	1,641,529
Visitors to Clark County (2003)	35,540,126 /year
Military Population (Permanent)	8,000
Military Population (Training)	350,000 /year
TOTAL Population	37,539,655

Average length of stay/visitor (nights) 3.4
[At 3.4 nights/person; 365 nights/year; 35,540,126 visitors per year = 331,059 visitors/night]

Visitor hairspray bump-up factor 1.25 additional uses per day
Visitor bump-up factor (other categories) 1 additional use per day

Military population/day (approximate) 14,712
[At 7 days/person training; 365 days/yr; plus 8,000 permanent population]

* "Miscellaneous" includes, but is not limited to, glass cleaners, paint remover, multipurpose solvents, sealants, caulking, oven cleaners, and laundry prewash.

Section 8.0 2008, 2013, 2018 VOC Emission Inventories

This section of the report discusses the formulation of and methodologies used for calendar year 2008, 2013, and 2018 projected emission inventories. The methodology used to perform the basic calculations within this section is the same as presented in Sections 6.0 and 7.0 of this report, adjusted for the projected populations for each year. The projected population figures are provided for 2008, 2013, and 2018 at the end of Tables 8.1, 8.2, and 8.3, respectively.

The projected populations for Clark County were obtained from the Advanced Planning Division (Comprehensive Planning) of Clark County. The projected number of visitors was based on a historical review of visitor volume from the 4th Quarter 2003 Las Vegas Marketing Bulletin - Vol. 31, No. 128. No increases in the permanent or training military population were assumed for the projection years.

Table 8.1
2008 Clark County Projected Emissions Inventory

Category	*California Emission Factor (lb/day/person)*	**Emissions from Permanent Residents of Clark County**	**Total VOC Emissions from Military Population (lb/day)**	**Emissions from Visitors to Clark County (lb/day)**	**Emissions from Additional Visitor Bump-up (lb/day)**	**Total VOC Emissions for Clark County (lb/day)**	**Total VOC Emissions for Clark County (ton/yr)**
Hair styling product: spray	8.73E-04	1,630.9	12.8	351.5	439.3	**2,434.5**	**444.3**
Automotive maintenance and repair	9.69E-04	1,811.4	14.3			**1,825.6**	**333.2**
Aerosol spray paints	9.64E-04	1,802.1	14.2			**1,816.3**	**331.5**
Insecticides	9.53E-04	1,781.5	14.0			**1,795.5**	**327.7**
Personal fragrance	5.19E-04	970.2	7.6	209.1		**1,186.9**	**216.6**
Packaged solvent	4.23E-04	790.4	6.2			**796.7**	**145.4**
Automotive detailing products	2.90E-04	541.7	4.3			**545.9**	**99.6**
General purpose degreaser	2.46E-04	460.7	3.6			**464.3**	**84.7**
Waxes and Polishes	2.44E-04	455.2	3.6			**458.7**	**83.7**
Toilet/Urinal Deodorizer	1.30E-04	242.2	1.9	52.2		**296.4**	**54.1**
Shaving gel	6.78E-05	126.7	1.0	27.3	27.3	**182.3**	**33.3**
Adhesive remover	7.62E-05	142.4	1.1			**143.5**	**26.2**
Personal hygiene product	5.14E-05	96.1	0.8	20.7	20.7	**138.3**	**25.2**
Fabric refresher	6.59E-05	123.1	1.0			**124.1**	**22.6**
Aerosol coating related products	6.01E-05	112.2	0.9			**113.1**	**20.6**
Shampoo	3.99E-05	74.6	0.6	16.1	16.1	**107.4**	**19.6**
Multi-purpose remover	5.45E-05	101.8	0.8			**102.6**	**18.7**
Insect Repellent: Non-aerosol	4.93E-05	92.1	0.7			**92.9**	**16.9**
Hair styling product: mousse	3.07E-05	57.4	0.5	12.4	12.4	**82.6**	**15.1**
Nail polish	2.53E-05	47.3	0.4	10.2	10.2	**68.1**	**12.4**
Conditioner	2.37E-05	44.2	0.3	9.5	9.5	**63.6**	**11.6**
Hair color product: permanent	2.07E-05	38.7	0.3	8.3		**47.3**	**8.64**
Electronic cleaner	2.05E-05	38.4	0.3			**38.7**	**7.06**
Wood cleaner	1.87E-05	34.9	0.3			**35.2**	**6.43**
Solvent parts cleaner: non-aerosol	1.74E-05	32.5	0.3			**32.7**	**5.97**
Footwear care product	1.43E-05	26.6	0.2	5.7		**32.6**	**5.95**
Toilet/Urinal Cleaner & Deodorizer	1.40E-05	26.2	0.2	5.6		**32.0**	**5.84**
Anti-static product	1.31E-05	24.5	0.2	5.3		**30.0**	**5.47**
Hair shine	1.04E-05	19.4	0.2	4.2	4.2	**27.9**	**5.09**
Fabric or leather waterproofer	1.18E-05	22.0	0.2			**22.2**	**4.05**
Body wipes	9.66E-06	18.0	0.1	3.9		**22.1**	**4.03**
Graffiti remover	9.81E-06	18.3	0.1			**18.5**	**3.37**
Hair styling product: liquid	6.68E-06	12.5	0.1	2.7	2.7	**18.0**	**3.28**
Leather care product	8.60E-06	16.1	0.1			**16.2**	**2.96**
Contact adhesive	8.25E-06	15.4	0.1			**15.5**	**2.84**
Hair styling product: semisolid	4.99E-06	9.3	0.1	2.0	2.0	**13.4**	**2.45**
Hair color product: temporary	5.06E-06	9.5	0.1	2.0		**11.6**	**2.11**
Personal foaming product	3.30E-06	6.2	0.05	1.3	1.3	**8.9**	**1.62**
Fungicides & Nematicides	3.86E-06	7.2	0.06			**7.3**	**1.33**
Toilet or urinal cleaner	2.93E-06	5.5	0.04	1.2		**6.7**	**1.22**
Nail treatment product	2.92E-06	5.5	0.04	1.2		**6.7**	**1.22**
Bleach/lightener	2.75E-06	5.1	0.04	1.1		**6.3**	**1.15**
Nail product: drying enhancer	2.21E-06	4.1	0.03	0.9		**5.1**	**0.92**
Top coat	1.80E-06	3.4	0.03	0.7		**4.1**	**0.75**
Base coat/undercoat	1.74E-06	3.3	0.03	0.7		**4.0**	**0.73**
Hair color product: semipermanent	9.57E-07	1.8	0.01	0.4		**2.2**	**0.40**
Hair color product: demipermanent	8.73E-07	1.6	0.01	0.4		**2.0**	**0.36**
Hair tonic/ Hair restorer	6.62E-07	1.2	0.01	0.3		**1.5**	**0.28**
Nail polish thinner	3.73E-07	0.7	0.01	0.2		**0.9**	**0.16**
Hair styling product: solid	9.83E-08	0.2	0.001	0.04	0.04	**0.3**	**0.05**
Artificial nail, wrap, or nail glue remover	6.94E-08	0.1	0.001	0.03		**0.2**	**0.03**
Jewelry cleaner	5.49E-08	0.1	0.001	0.02		**0.1**	**0.02**
Other hair care products	1.73E-08	0.03	0.0003	0.01	0.01	**0.05**	**0.01**
Miscellaneous *	1.54E-03	2,884.4	22.7			**2,907.1**	**530.5**
Emissions Grand Total		**14,797.0**	**116.5**	**757.1**	**545.8**	**16,216.4**	**2,959.5**

Table 8.1
2008 Clark County Projected Emissions Inventory (continued)

Assumptions

Clark County projected population (2008)	1,869,039
Projected Visitors to Clark County (2008)	43,239,997 / year
Military Population (Permanent)	8,000
Military Population (Training)	350,000 / year
TOTAL Population	**45,467,036**

Average length of stay/visitor (nights) 3.4
[At 3.4 nights/person; 365 nights/year; 43,239,997 visitors per year = 402,784 visitors/night]

Visitor hairspray bump-up factor	1.25 additional uses per day
Visitor bump-up factor (other categories)	1 additional use per day

Military population/day (approximate) 14,712
[At 7 days/person training; 365 days/yr; plus 8,000 permanent population]

Notes:
Projected population for Clark County obtained from Advanced Planning Division (Comprehensive Planning) of Clark County

Projected visitors based on historical review of visitor volume from 4th Quarter 2003 Las Vegas Marketing Bulletin - Vol. 31, No. 128.

* "Miscellaneous" includes, but is not limited to, glass cleaners, paint remover, multipurpose solvents, sealants, caulking, oven cleaners, and laundry prewash.

Table 8.2
2013 Clark County Projected Emissions Inventory

Category	*California Emission Factor (lb/day/person)*	**Emissions from Permanent Residents of Clark County**	**Total VOC Emissions from Military Population (lb/day)**	**Emissions from Visitors to Clark County (lb/day)**	**Emissions from Additional Visitor Bump-up (lb/day)**	**Total VOC Emissions for Clark County (lb/day)**	**Total VOC Emissions for Clark County (ton/yr)**
Hair styling product: spray	8.73E-04	1,792.0	12.8	427.6	534.5	**2,767.0**	**505.0**
Automotive maintenance and repair	9.69E-04	1,990.4	14.3			**2,004.6**	**365.8**
Aerosol spray paints	9.64E-04	1,980.2	14.2			**1,994.4**	**364.0**
Insecticides	9.53E-04	1,957.5	14.0			**1,971.6**	**359.8**
Personal fragrance	5.19E-04	1,066.0	7.6	254.4		**1,328.0**	**242.4**
Packaged solvent	4.23E-04	868.5	6.2			**874.8**	**159.6**
Automotive detailing products	2.90E-04	595.2	4.3			**599.4**	**109.4**
General purpose degreaser	2.46E-04	506.2	3.6			**509.8**	**93.0**
Waxes and Polishes	2.44E-04	500.1	3.6			**503.7**	**91.9**
Toilet/Urinal Deodorizer	1.30E-04	266.2	1.9	63.5		**331.6**	**60.5**
Shaving gel	6.78E-05	139.2	1.0	33.2	33.2	**206.7**	**37.7**
Adhesive remover	7.62E-05	156.4	1.1			**157.6**	**28.8**
Personal hygiene product	5.14E-05	105.6	0.8	25.2	25.2	**156.8**	**28.6**
Fabric refresher	6.59E-05	135.3	1.0			**136.2**	**24.9**
Aerosol coating related products	6.01E-05	123.3	0.9			**124.2**	**22.7**
Shampoo	3.99E-05	82.0	0.6	19.6	19.6	**121.7**	**22.2**
Multi-purpose remover	5.45E-05	111.9	0.8			**112.7**	**20.6**
Insect Repellent: Non-aerosol	4.93E-05	101.2	0.7			**102.0**	**18.6**
Hair styling product: mousse	3.07E-05	63.1	0.5	15.1	15.1	**93.6**	**17.1**
Nail polish	2.53E-05	52.0	0.4	12.4	12.4	**77.2**	**14.1**
Conditioner	2.37E-05	48.6	0.3	11.6	11.6	**72.1**	**13.2**
Hair color product: permanent	2.07E-05	42.5	0.3	10.1		**52.9**	**9.66**
Electronic cleaner	2.05E-05	42.2	0.3			**42.5**	**7.76**
Wood cleaner	1.87E-05	38.4	0.3			**38.7**	**7.06**
Solvent parts cleaner: non-aerosol	1.74E-05	35.7	0.3			**35.9**	**6.56**
Footwear care product	1.43E-05	29.3	0.2	7.0		**36.5**	**6.65**
Toilet/Urinal Cleaner & Deodorizer	1.40E-05	28.7	0.2	6.9		**35.8**	**6.53**
Anti-static product	1.31E-05	26.9	0.2	6.4		**33.5**	**6.12**
Hair shine	1.04E-05	21.3	0.2	5.1	5.1	**31.6**	**5.77**
Fabric or leather waterproofer	1.18E-05	24.2	0.2			**24.4**	**4.45**
Body wipes	9.66E-06	19.8	0.1	4.7		**24.7**	**4.51**
Graffiti remover	9.81E-06	20.1	0.1			**20.3**	**3.70**
Hair styling product: liquid	6.68E-06	13.7	0.1	3.3	3.3	**20.4**	**3.72**
Leather care product	8.60E-06	17.7	0.1			**17.8**	**3.25**
Contact adhesive	8.25E-06	16.9	0.1			**17.1**	**3.11**
Hair styling product: semisolid	4.99E-06	10.2	0.1	2.4	2.4	**15.2**	**2.78**
Hair color product: temporary	5.06E-06	10.4	0.1	2.5		**12.9**	**2.36**
Personal foaming product	3.30E-06	6.8	0.05	1.6	1.6	**10.1**	**1.84**
Fungicides & Nematicides	3.86E-06	7.9	0.06			**8.0**	**1.46**
Toilet or urinal cleaner	2.93E-06	6.0	0.04	1.4		**7.5**	**1.37**
Nail treatment product	2.92E-06	6.0	0.04	1.4		**7.5**	**1.36**
Bleach/lightener	2.75E-06	5.7	0.04	1.3		**7.0**	**1.29**
Nail product: drying enhancer	2.21E-06	4.5	0.03	1.1		**5.7**	**1.03**
Top coat	1.80E-06	3.7	0.03	0.9		**4.6**	**0.84**
Base coat/undercoat	1.74E-06	3.6	0.03	0.9		**4.5**	**0.81**
Hair color product: semipermanent	9.57E-07	2.0	0.01	0.5		**2.4**	**0.45**
Hair color product: demipermanent	8.73E-07	1.8	0.01	0.4		**2.2**	**0.41**
Hair tonic/ Hair restorer	6.62E-07	1.4	0.01	0.3		**1.7**	**0.31**
Nail polish thinner	3.73E-07	0.8	0.01	0.2		**1.0**	**0.17**
Hair styling product: solid	9.83E-08	0.2	0.001	0.05	0.05	**0.3**	**0.05**
Artificial nail, wrap, or nail glue remover	6.94E-08	0.1	0.001	0.03		**0.2**	**0.03**
Jewelry cleaner	5.49E-08	0.1	0.001	0.03		**0.1**	**0.03**
Other hair care products	1.73E-08	0.04	0.0003	0.01	0.01	**0.1**	**0.01**
Miscellaneous *	1.54E-03	3,169.4	22.7			**3,192.1**	**582.6**
Emissions Grand Total		**16,259.2**	**116.5**	**921.1**	**664.0**	**17,960.8**	**3,277.9**

Table 8.2
2013 Clark County Projected Emissions Inventory (continued)

Assumptions

Clark County projected population (2013)	2,053,728
Projected Visitors to Clark County (2013)	52,608,068 / year
Military Population (Permanent)	8,000
Military Population (Training)	350,000 / year
TOTAL Population	**55,019,796**

Average length of stay/visitor (nights) 3.4
[At 3.4 nights/person; 365 nights/year; 52,608,068 visitors per year = 490,048 visitors/night]

Visitor hairspray bump-up factor	1.25 additional uses per day
Visitor bump-up factor (other categories)	1 additional use per day

Military population/day (approximate) 14,712
[At 7 days/person training; 365 days/yr; plus 8,000 permanent population]

Notes:
Projected population for Clark County obtained from Advanced Planning Division (Comprehensive Planning) of Clark County

Projected visitors based on historical review of visitor volume from 4th Quarter 2003 Las Vegas Marketing Bulletin - Vol. 31, No. 128.

* "Miscellaneous" includes, but is not limited to, glass cleaners, paint remover, multipurpose solvents, sealants, caulking, oven cleaners, and laundry prewash.

Table 8.3
2018 Clark County Projected Emissions Inventory

Category	*California Emission Factor (lb/day/person)*	Emissions from Permanent Residents of Clark County	Total VOC Emissions from Military Population (lb/day)	Emissions from Visitors to Clark County (lb/day)	Emissions from Additional Visitor Bump-up (lb/day)	Total VOC Emissions for Clark County (lb/day)	Total VOC Emissions for Clark County (ton/yr)
Hair styling product: spray	8.73E-04	1,933.1	12.8	520.2	650.3	**3,116.5**	**568.8**
Automotive maintenance and repair	9.69E-04	2,147.0	14.3			**2,161.3**	**394.4**
Aerosol spray paints	9.64E-04	2,136.0	14.2			**2,150.2**	**392.4**
Insecticides	9.53E-04	2,111.6	14.0			**2,125.6**	**387.9**
Personal fragrance	5.19E-04	1,149.9	7.6	309.5		**1,467.0**	**267.7**
Packaged solvent	4.23E-04	936.9	6.2			**943.1**	**172.1**
Automotive detailing products	2.90E-04	642.0	4.3			**646.3**	**117.9**
General purpose degreaser	2.46E-04	546.0	3.6			**549.7**	**100.3**
Waxes and Polishes	2.44E-04	539.5	3.6			**543.1**	**99.1**
Toilet/Urinal Deodorizer	1.30E-04	287.1	1.9	77.3		**366.3**	**66.9**
Shaving gel	6.78E-05	150.2	1.0	40.4	40.4	**232.0**	**42.3**
Adhesive remover	7.62E-05	168.7	1.1			**169.9**	**31.0**
Personal hygiene product	5.14E-05	113.9	0.8	30.7	30.7	**176.0**	**32.1**
Fabric refresher	6.59E-05	145.9	1.0			**146.9**	**26.8**
Aerosol coating related products	6.01E-05	133.0	0.9			**133.9**	**24.4**
Shampoo	3.99E-05	88.4	0.6	23.8	23.8	**136.6**	**24.9**
Multi-purpose remover	5.45E-05	120.7	0.8			**121.5**	**22.2**
Insect Repellent: Non-aerosol	4.93E-05	109.2	0.7			**109.9**	**20.1**
Hair styling product: mousse	3.07E-05	68.0	0.5	18.3	18.3	**105.1**	**19.2**
Nail polish	2.53E-05	56.1	0.4	15.1	15.1	**86.6**	**15.8**
Conditioner	2.37E-05	52.4	0.3	14.1	14.1	**81.0**	**14.8**
Hair color product: permanent	2.07E-05	45.8	0.3	12.3		**58.5**	**10.7**
Electronic cleaner	2.05E-05	45.5	0.3			**45.8**	**8.36**
Wood cleaner	1.87E-05	41.4	0.3			**41.7**	**7.61**
Solvent parts cleaner: non-aerosol	1.74E-05	38.5	0.3			**38.7**	**7.07**
Footwear care product	1.43E-05	31.6	0.2	8.5		**40.3**	**7.35**
Toilet/Urinal Cleaner & Deodorizer	1.40E-05	31.0	0.2	8.3		**39.6**	**7.22**
Anti-static product	1.31E-05	29.0	0.2	7.8		**37.1**	**6.76**
Hair shine	1.04E-05	23.0	0.2	6.2	6.2	**35.5**	**6.48**
Fabric or leather waterproofer	1.18E-05	26.1	0.2			**26.3**	**4.80**
Body wipes	9.66E-06	21.4	0.1	5.8		**27.3**	**4.98**
Graffiti remover	9.81E-06	21.7	0.1			**21.9**	**3.99**
Hair styling product: liquid	6.68E-06	14.8	0.1	4.0	4.0	**22.9**	**4.18**
Leather care product	8.60E-06	19.1	0.1			**19.2**	**3.50**
Contact adhesive	8.25E-06	18.3	0.1			**18.4**	**3.36**
Hair styling product: semisolid	4.99E-06	11.1	0.1	3.0	3.0	**17.1**	**3.12**
Hair color product: temporary	5.06E-06	11.2	0.1	3.0		**14.3**	**2.61**
Personal foaming product	3.30E-06	7.3	0.05	2.0	2.0	**11.3**	**2.06**
Fungicides & Nematicides	3.86E-06	8.5	0.06			**8.6**	**1.57**
Toilet or urinal cleaner	2.93E-06	6.5	0.04	1.7		**8.3**	**1.51**
Nail treatment product	2.92E-06	6.5	0.04	1.7		**8.3**	**1.51**
Bleach/lightener	2.75E-06	6.1	0.04	1.6		**7.8**	**1.42**
Nail product: drying enhancer	2.21E-06	4.9	0.03	1.3		**6.3**	**1.14**
Top coat	1.80E-06	4.0	0.03	1.1		**5.1**	**0.93**
Base coat/undercoat	1.74E-06	3.9	0.03	1.0		**4.9**	**0.90**
Hair color product: semipermanent	9.57E-07	2.1	0.01	0.6		**2.7**	**0.49**
Hair color product: demipermanent	8.73E-07	1.9	0.01	0.5		**2.5**	**0.45**
Hair tonic/ Hair restorer	6.62E-07	1.5	0.01	0.4		**1.9**	**0.34**
Nail polish thinner	3.73E-07	0.8	0.01	0.2		**1.1**	**0.19**
Hair styling product: solid	9.83E-08	0.2	0.001	0.06	0.06	**0.3**	**0.06**
Artificial nail, wrap, or nail glue remover	6.94E-08	0.2	0.001	0.04		**0.2**	**0.04**
Jewelry cleaner	5.49E-08	0.1	0.001	0.03		**0.2**	**0.03**
Other hair care products	1.73E-08	0.04	0.0003	0.01	0.01	**0.1**	**0.01**
Miscellaneous *	1.54E-03	3,418.9	22.7			**3,441.6**	**628.1**
Emissions Grand Total		**17,538.9**	**116.5**	**1,120.7**	**807.9**	**19,583.9**	**3,574.1**

Table 8.3
2018 Clark County Projected Emissions Inventory (continued)

Assumptions

Clark County projected population (2018)	2,215,363
Projected Visitors to Clark County (2018)	64,005,759 / year
Military Population (Permanent)	8,000
Military Population (Training)	350,000 / year
TOTAL Population	**66,579,122**

Average length of stay/visitor (nights) 3.4
[At 3.4 nights/person; 365 nights/year; 64,005,759 visitors per year = 596,218 visitors/night]

Visitor hairspray bump-up factor	1.25 additional uses per day
Visitor bump-up factor (other categories)	1 additional use per day

Military population/day (approximate) 14,712
[At 7 days/person training; 365 days/yr; plus 8,000 permanent population]

Notes:
Projected population for Clark County obtained from Advanced Planning Division (Comprehensive Planning) of Clark County

Projected visitors based on historical review of visitor volume from 4th Quarter 2003 Las Vegas Marketing Bulletin - Vol. 31, No. 128.

* "Miscellaneous" includes, but is not limited to, glass cleaners, paint remover, multipurpose solvents, sealants, caulking, oven cleaners, and laundry prewash.

Section 9.0 Control and Mitigation of Consumer Product VOC Emissions

This section discusses mitigation and control measures for VOC emissions from consumer products. MACTEC reviewed literature and regulations for reducing VOC emissions from regulated and unregulated product categories using the control measures of product reformulation, change in application method, product substitution, and product banning.

One method of reducing VOC emissions from consumer products is by product reformulation. The EPA required manufacturer to complete reformulation of certain products by December 1998. MACTEC estimates that the Federal implementation of 40 CFR Part 59 regulations has already resulted in a 6.6% reduction in VOC emissions in Clark County, which has already been reflected in out calculations of the base year emissions.

VOC emissions from most consumer product use are a result of the propellant or delivery/ packaging system and the product formulation chemical composition. Product formulation and reformulation information is generally company sensitive and confidential so specific information is proprietary, although the common practice is to add more water to the product and/or to modify the formulae using components with a lower VOC content. This control strategy also relies on controlling the emissions during the delivery, which is accomplished through changing the pressure and or composition of the propellant to a non–VOC composition, modifying the delivery system, and changing the delivery phase and application method.

The Ozone Transport Commissions (OTC) has developed model regulations to assist states in the Great Lakes and the Northeast in reducing VOC emissions from this category. These suggested rules are not as stringent as the ones adopted and being proposed by the California Air Resources Board (CARB). Table 9.1 summarizes the potential reduction in emissions that could result from the implementation of the OTC rules and the CARB rules, assuming that each were implemented in Clark County. Although manufacturers of consumer products have expressly objected to the CARB limits, there may be some merit in DAQEM adopting these regulations due to the proximity to California (i.e., if manufacturers would be required to ship products within California, they could easily ship just beyond the California line into Clark County).

Table 9.1
Control Measure Summary

Control Measure Summary	Rough Estimation of VOC Emission Reductions (tons/year)	
2002 existing measure: Federal Consumer & Commercial Products Rules 40CFR Part 59 *Emission Reductions*: **Overall 6.6%** from uncontrolled levels (20% reduction for products covered by rule, only 40% of all products are covered by the rule) *Control Cost*: $273 per ton *Timing of Implementation*: Compliance required by December 1998 *Implementation Area:* Nationwide	Uncontrolled: 2002 Reduction: 2002 Base:	2,662 -176 2,486
Candidate Measure: Adopt OTC Model Rules with additional product coverage and more stringent VOC limits *Emission Reductions*: **11.6% beyond Federal Part 59 Rule** (for a total reduction of 17.4% from uncontrolled emissions) *Control Cost*: $800 per ton *Timing of Implementation*: Assuming 2007 effective date of rule and 2-year sell through period, emission reductions are achieved in 2009	2002 Base: 2009 Reduction: 2009 Remaining:	2,486 -288 2,198
Candidate Measure: Adopt CARB 2003 SIP requirements with additional products and more stringent VOC limits (in addition to OTC Model Rule) *Emission Reductions*: **10.2% beyond OTC Model Rule** (for a total reduction of 27.0% from uncontrolled emissions) *Control Cost*: $4,800 ton *Timing of Implementation*: Assuming 2007 effective date of rule and 2-year sell through period, emission reductions are achieved in 2009	2002 Base: 2009 Reduction: 2009 Remaining:	2,486 -542 1,944

Both California and New York have formulated VOC content limits by source category, with some categories broken down into more detailed product categories (e.g., insecticides can be further broken down by foggers, lawn and garden, flying bugs, etc.). Each of these limits has a date by which manufacturers and retailers must comply and/or apply for a variance with the more stringent VOC limits.

Currently, California has five consumer product regulations:

1. antiperspirants and deodorants,
2. general consumer products,
3. aerosols and coatings,
4. emissions trading for VOC from consumer products, and
5. hairspray credit program

These regulations focus on setting VOC content limits for each product category. Tables 9.2 and 9.3 provide the VOC standards and effective dates for various consumer product categories subject to regulation in California. Table 9.4 provides Federal VOC standards, effective September 11, 1998, for various consumer product categories that are used in other states, including those used in Clark County. The formulator and/or manufacturer must determine how to meet these standards. CARB continues to look at new innovative approaches to achieve further VOC reductions from consumer products including, but not limited to, alternative packaging technologies and zero or near zero emission technologies.

Table 9.2
CARB Standards for Antiperspirants and Deodorants

Table of Standards

For products manufactured beginning January 1, 2001
(percent volatile organic compounds by weight)

	Effective Dates 1/1/01 HVOC[a]	Effective Dates 1/1/01 MVOC[b]
Aerosol Products		
Antiperspirants	40	10
Deodorants	0	10
Non-Aerosol Products	0	0

[a] High volatility organic compounds, i.e., any organic compound that exerts a vapor pressure greater than 80 mm Hg when measured at 20 C.

[b] Medium volatility organic compounds, i.e., any organic compound that exerts a vapor pressure greater than 2 mm Hg and less than or equal to 80 mm Hg when measured at 20 C.

Table 9.3
CARB Standards for Consumer Products

Table of Standards
Percent Volatile Organic Compound by Weight

Product Category	Effective Date [1]	VOC Standard [2]
Adhesive Removers*:		
Floor or Wall Covering Adhesive Remover	12/31/2006	5
Gasket or Thread Locking Adhesive Remover	12/31/2006	50
General Purpose Adhesive Remover	12/31/2006	20
Specialty Adhesive Remover	12/31/2006	70
[*See section 94509(n) for additional requirements that apply to adhesive removers.]		
Adhesives *: Aerosol	1/1/95	75
mist spray adhesives	1/1/2002	65
web spray adhesives	1/1/2002	55
special purpose spray adhesives		
mounting, automotive engine compartment, and flexible vinyl adhesives	1/1/2002	70
polystyrene foam and automobile headliner adhesives	1/1/2002	65
polyolefin and laminate repair/edgebanding adhesives	1/1/2002	60
[See 94509~~(i)~~~~(i)~~(i), 94512(d), and 94513(d) for additional requirements that apply to aerosol adhesives.]		
construction, panel, and floor covering**	1/1/95 12/31/2002	40 15

Table 9.3
CARB Standards for Consumer Products (continued)

contact	1/1/95	80
contact adhesive – general purpose	12/31/2006	55
contact adhesive – special purpose	12/31/2006	80
[See section 94509~~(n)~~(m) for additional requirements that apply to contact adhesives.]		
general purpose	1/1/95	10
* See section 94510(i) for an exemption that applies to adhesives sold in containers of one fluid ounce or less. ** See section 94509~~(k)(l)~~(k) for the effective date of the VOC limit for certain types of "construction, panel, and floor covering adhesives."		
Aerosol Cooking Sprays	1/1/95	18
Air Fresheners*: Double phase aerosols	1/1/93 12/31/2004	30 25
single phase aerosols	1/1/93 1/1/96	70 30
dual purpose air fresheners/disinfectant aerosols	1/1/94	60
liquid/pump sprays	1/1/93	18
solids/~~gels~~semisolid	1/1/93	3
[*See sections~~s~~ 94510(f) ~~and 94510(g)~~ and 94510(g)(2) for ~~an~~ exemptions~~s~~ that apply~~ies~~y to certain air fresheners, and 94509(o) for additional requirements that apply to air fresheners.]		
Anti-static Product: Aerosol	12/31/2008	80
non-aerosol	12/31/2006	11
Automotive Brake Cleaners	1/1/97 12/31/2002	50 45
Automotive Rubbing or Polishing Compounds	1/1/2005	17

Table 9.3
CARB Standards for Consumer Products (continued)

Automotive Wax/Polish/Sealant/Glaze: all other forms	1/1/2005	15
hard paste waxes	1/1/2005	45
instant detailers	1/1/2001	3
Automotive Windshield Washer Fluids: Type "A" areas*	1/1/93	35
All other areas (all forms) Dilutable and Pre-Mixed [1/]	1/1/93 12/31/2002	10 1
[1/] See section 94508(a)(~~18~~)~~(19)~~(20), section 94508(a)~~(19)(20)~~(21), and section 94509~~(l)(m)~~(l) for provisions that apply to Automotive Windshield Washer Fluids.		
* Type "A" areas include only the following: Del Norte, Shasta and Trinity Counties; the Great Basin Valley, Lake Tahoe, Mountain Counties, and Northeast Plateau Air Basins, as defined in Title 17, California Code of Regulations, Sections 60105, 60108, 60111, and 60113.		
Bathroom and Tile Cleaners: aerosols	1/1/94	7
all other forms	1/1/94	5
Bug and Tar Remover	1/1/2002	40
Carburetor or Fuel-injection Air Intake Cleaners **	1/1/95 12/31/2002	75 45
** See section 94509~~(k)(l)~~(k) for the effective date of the VOC limit for fuel-injection air intake cleaners.		
Carpet and Upholstery Cleaner: Aerosols	1/1/2001	7
non-aerosols (dilutables)	1/1/2001	.1
non-aerosols (ready-to-use)	1/1/2001	3
Charcoal Lighter Material	See 94509~~(h)(i)~~(h)	
Dusting Aids: Aerosol	1/1/95 1/1/97	35 25
all other forms	1/1/95	7

Table 9.3
CARB Standards for Consumer Products (continued)

Electrical Cleaner* [*See section 94509(n) for additional requirements that apply to electrical cleaners.]	12/31/2006	45
Electronic Cleaner* [*See section 94509~~(n)~~(m) for additional requirements that apply to electronic cleaners.]	12/31/2006	75
Engine Degreasers ~~(all forms)~~:	1/1/93 1/1/96	75 50
aerosols	12/31/2004	35
non-aerosols	12/31/2004	5
Fabric Refresher: Aerosol	12/31/2006	15
non-aerosol	12/31/2006	6
Fabric Protectants	1/1/95 1/1/97	75 60
Floor Polishes/Waxes: products for flexible flooring materials	1/1/94	7
products for nonresilient flooring	1/1/94	10
wood floor wax	1/1/94	90
Floor Wax Stripper: non-aerosols	See Section 94509~~(j)(k)~~(j)	
Footware or Leather Care Product*: Aerosol	12/31/2006	75
solid	12/31/2006	55
all other forms [*See section 94509~~(n)~~(m) for additional requirements that apply to footware or leather care products.]	12/31/2006	15
Furniture Maintenance Products: Aerosols	1/1/94 12/31/2004	25 17
all other forms (except solid/paste forms)	1/1/94	7

Table 9.3
CARB Standards for Consumer Products (continued)

General Purpose Cleaners aerosols and non-aerosols:	1/1/94	10
non-aerosols	12/31/2004	4
General Purpose Degreasers*: Aerosols	1/1/2002	50
non-aerosols [*See section 94509~~(n)~~(m) for additional requirements that apply to general purpose degreasers.]	12/31/2004	4
Glass Cleaners: Aerosols	1/1/93	12
non-aerosols	1/1/93 1/1/96 12/31/2004	8 6 4
Graffiti Remover*: Aerosols	12/31/2006	50
non-aerosols [*See section 94509(n) for additional requirements that apply to graffiti removers.]	12/31/2006	30
Hair Mousses	1/1/94 12/31/2002	16 6
Hair Shine	1/1/2005	55
~~Hairsprays~~ Hair Spray	1/1/93 6/1/99	80 55
Hair Styling Gels	1/1/94	6
Hair Styling Product aerosols and pump sprays	12/31/2006	6
all other forms	12/31/2006	2
Heavy-duty Hand Cleaners or Soap	1/1/2005	8
Insect Repellents: Aerosols	1/1/94	65
Insecticides*: crawling bug (all forms):	1/1/95 1/1/98	40 20
aerosol crawling bug insecticides	12/31/2004	15
flea and tick	1/1/95	25

Table 9.3
CARB Standards for Consumer Products (continued)

flying bug (all forms):	1/1/95	35
aerosols	12/31/2003	25
foggers	1/1/95	45
lawn and garden (all forms)	1/1/95	20
non-aerosol lawn and garden insecticides	12/31/2003	3
wasp and hornet	1/1/2005	40
* See sections 94510(g)(1) and 94510(k) for exemptions that apply to certain insecticides.		
Laundry Prewash: aerosols/solids	1/1/94	22
all other forms	1/1/94	5
Laundry Starch Products	1/1/95	5
Metal Polish/Cleanser	1/1/2005	30
Multi-purpose Lubricant: (excluding solid or semisolid products)	1/1/2003	50
Nail Polish Removers	1/1/94 1/1/96 12/31/2004	85 75 0
Non-selective Terrestrial Herbicide: non-aerosols	1/1/2002	3
Oven Cleaners: aerosols/pump sprays	1/1/93	8
liquids	1/1/93	5
Paint Remover or Stripper	1/1/2005	50
Penetrant	1/1/2003	50
Personal Fragrance Products*: products with 20% or less fragrance	1/1/95 1/1/99	80 75
products with more than 20% fragrance	1/1/95 1/1/99	70 65
* See sections 94510(h), 94510(j), and 94510(l) for exemptions that apply to personal fragrance products.		

Table 9.3
CARB Standards for Consumer Products (continued)

Rubber and Vinyl Protectant: Aerosols	1/1/2005	10
non-aerosols	1/1/2003	3
Sealants and Caulking Compounds	12/31/2002	4
Shaving Creams	1/1/94	5
Shaving Gel	12/31/2006 12/31/2009	7 4
Silicone-based Multi-purpose Lubricant: (excluding solid or semisolid products)	1/1/2005	60
Spot Remover: Aaerosols	1/1/2001	25
non-aerosols	1/1/2001	8
Tire Sealants and Inflators	12/31/2002	20
Toilet/Urinal Care Product:* Aerosol	12/31/2006	10
non-aerosol [See section 94509(o) for additional requirements that apply to Toilet/Urinal Care Products]	12/31/2006	3
Undercoating: Aerosols	1/1/2002	40
~~Wasp and Hornet Insecticide~~	~~1/1/2005~~	~~40~~
Wood Cleaner: Aerosol	12/31/2006	17
non-aerosol	12/31/2006	4

[1] See section 94509~~(d)(e)~~(d) for the effective date of the VOC standards for products registered under FIFRA, and section 94509(c) and (d) for the "Sell-through" allowed for products manufactured prior to the effective date of standards.

[2] See section 94510(c) for an exemption that applies to fragrances in consumer products, and section 94510(d) for an exemption that applies to LVP-VOCs.

Table 9.4
Federal VOC Standards for Consumer Products

Product Category	Federal VOC content limit (wt %)
Bathroom & tile cleaners: Aerosols	7
Bathroom & tile cleaners: All other forms	5
Fabric protectants	75
Furniture maintenance products – aerosol	25
General purpose cleaners	10
Hairsprays	80
Hair mousses	16
Hair styling gels	6
Household adhesives: Contact adhesive	80
Insecticides: Lawn and garden	20
Nail polish removers	85
Shaving creams	5
Underarm antiperspirants: Aerosol	60
Underarm deodorants: Aerosol	20

The VOC standards established by CARB for various products have often resulted in a manufacturer(s) applying for a variance and requesting time to allow development of a VOC-conforming product. CARB allows the product formulator or manufacturer to consider mitigation options for reducing excess emissions generated during the variance period. Examples of these options are listed below:

- An applicant could temporarily or permanently generate emission reductions by reducing VOC content of one or more regulated or unregulated consumer products they sell in California and

- An applicant could acquire or purchase emission reductions from another company that sells regulated or unregulated consumer products in California.

Should Clark County decide to develop regulations for consumer product categories that are significant sources of VOC emissions, then MACTEC suggests adopting the relevant standards established and implemented in California along with a market-based regulation comparable to California's regulation 4, Alternative Control Plan (ACP), which is an alternative way to comply with the VOC limits.

Appendix A
Survey Forms

Clark County Consumer Products Survey

Firm Name: ____________________ **Contact Person:** ____________________

Address: ______________________ **Telephone:** ________________________

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Please indicate which of the following best describes your company's operations:

- ☐ Distribution Only – complete Part A only
- ☐ Manufacturing Only – complete Parts A & B
- ☐ Both Manufacturing and Distribution – complete Parts A & B
- ☐ No Distribution or Manufacturing of any product whose type is listed – please check and return form

Part A. Product Distribution Data				
1. Product Number	**2. Brand Name (on label)**	**3. Product Type**	**4. Dispensing Form**	**5. Annual Sales Volume (lb/yr)**

(Photocopy and attach additional pages if necessary)

Manufacturers continue to Part B

MACTEC

Clark County Consumer Products Survey

Part B. Product Composition						
6. Product Number	7. Chemical Name	8. CAS #	9. Wt %	10. Active/ Nonactive	11. Pro-pellant	

(Photocopy and attach additional pages if necessary)

MACTEC

Information/Directions for Clark County Consumer Products Survey

If your company is a **Distributor Only**, complete Part A only and provide the name and address of the manufacturer of all products that you distribute.

If your company is a **Manufacturer Only**, complete Parts A & B.

If your company is **Both a Manufacturer and Distributor**, complete Parts A & B.

If your company is **Neither a Manufacturer nor Distributor** of any product whose type is listed, please complete identification and return form.

Please photocopy forms if sufficient space is not provided.

Example Form – Completed.

Part A. Product Distribution Data				
1. Product Number	2. Brand Name (on label)	3. Product Type	4. Dispensing Form	5. Annual Sales Volume (lb/yr)
1	Lysol Toilet Cleaner	D	L	500,000

Part B. Product Composition						
6. Product Number	7. Chemical Name	8. CAS #	9. Wt. %	10. Active/ Nonactive	11. Propellant	
1	Ammonia	8030-30-6	10.2	A		
	Chlorine	63-25-2	3.0	A		
	Others	106-97-8	77.8	N		

Description of Information Required

1. **Product Number:** Number each product consecutively 1, 2, 3, etc., e.g., the Product Number for the first product listed should be "1," "2" for the second product, "3" for the third, and so on. Air fresheners with the same brand name, but with different scents, i.e., the only significant difference is the fragrance used, should be listed as a single product.
2. **Brand Name:** List the brand name of each product exactly as it appears on the label.
3. **Product Type:** Use the following letter codes to describe the product type:
   A – Adhesives (not including industrial adhesives) – Any product specifically formulated to cause a firm attachment (adherence) by cohesion or bonding, either temporary or permanent between two surfaces.
   C – All Purpose Cleaners – Any general cleaning product that is formulated to be used on a variety of washable surfaces to perform a variety of cleaning tasks.
   D – Disinfectants – Any product which makes a disinfectant claim, i.e., use of the product is intended to destroy or irreversibly inactivate infectious or other undesirable bacteria, pathogenic fungi, or viruses on surfaces or inanimate objects, and is regulated pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These do not include personal hygiene products.

F – Air Fresheners – Any product which is marketed for the purpose of masking or deodorizing indoor air odors. These do not include personal hygiene products.
H – Hair Sprays, Spritzes, etc. (not including foam mousses) – Any hair control, setting, or styling product dispensed from a propellant aerosol can, a mechanical pump spray container, or any other type of spray container. These do not include styling mousse products.

An insecticide is a substance or mixture of substances marketed for the purpose of preventing, destroying, or mitigating and insects, and which is regulated pursuant to FIFRA. These do not include personal hygiene products. The following are specific subcategories of insecticides:
IR – Insect Repellants

4. **Dispensing Form**: Use the following letter codes to describe the dispensing form:
   S – Solid
   L – Liquid
   A – Aerosol
   P – Pump
   O – Other (describe)
5. **Clark County Annual Sales Volume for 2003:** Based on DAQM Survey
6. **Product Number:** Use product number assigned in Part A.
7. **Chemical Name:** List the name of all ingredients contained in the product. Use proper chemical names as defined by IUPAC (International Union of Pure and Applied Chemists) or CAS (Chemical Abstracts Service) rules of nomenclature. Please note that: *All nonactive ingredients whose weight percent in aggregate is less than 2 percent need not be identified*.
8. **CAS #:** Chemical Abstract Service Registry Number for each ingredient.
9. **Weight %:** List the amount of each ingredient contained in the product as a percentage of the total product weight.
10. **Active/Nonactive:** Indicate for each chemical compound whether it is an active or nonactive ingredient using the following letter codes:
    A – Active Ingredient
    N – Nonactive (Inert) Ingredient
11. **Propellant:** If an ingredient is used as the aerosol propellant, please be sure columns 6 through 9 are completed for this compound and also place a 'Y' in this column.

Clark County Consumer Products Survey

Hotel Name(s): ________________ **Contact Person:** ___________________

Address: ______________________ **Telephone:** _______________________

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Please indicate which of the following best describes operations at your hotels:

- ☐ Use of Products by Hotel Employees Only
- ☐ Sale of Products in Gift Shop Only
- ☐ Both Use and Sale of Products
- ☐ No Use or Sale of any product whose type is listed – please check and return form

Part A. Product Use or Sales Data				
1. Product Number	**2. Brand Name (on label)**	**3. Product Type**	**4. Dispensing Form**	**5. Annual Use or Sales Volume (lb/yr)**

(Photocopy and attach additional pages as needed)

MACTEC

Clark County Consumer Products Survey

Part B. Product Composition						
6. Product Number	7. Chemical Name	8. CAS #	9. Wt %	10. Active/ Nonactive	11. Pro-pellant	

(Photocopy and attach additional pages as needed)

Page ___ of ___

Information/Directions for
Clark County Consumer Products Survey

If your hotels are consumer products **Users Only**, complete Part A and if possible complete Part B, but if you cannot complete Part B, provide the name and address of the manufacturer of all products that you use.

If your hotels are **Users and Sellers**, complete Parts A & B but if you cannot complete Part B, provide the name and address of the manufacturer of all products that you sell.

If your hotels are **Neither Users nor Sellers** of any product whose type is listed, please complete identification and return form.

Please photocopy forms as needed.

Example Form – Completed.

Part A. Product Distribution Data				
1. Product Number	2. Brand Name (on label)	3. Product Type	4. Dispensing Form	5. Annual Sales Volume (lb/yr)
1	Lysol Toilet Cleaner	Leave Blank	L	500,000

Part B. Product Composition						
6. Product Number	7. Chemical Name	8. CAS #	9. Wt. %	10. Active/ Nonactive	11. Propellant	
1	Ammonia	8030-30-6	10.2	A		
	Chlorine	63-25-2	3.0	A		
	Others	106-97-8	77.8	N		

Description of Information Required

12. **Product Number:** Number each product consecutively 1, 2, 3, etc., e.g., the Product Number for the first product listed should be "1," "2" for the second product, "3" for the third, and so on. Air fresheners with the same brand name, but with different scents, i.e., the only significant difference is the fragrance used, should be listed as a single product.
13. **Brand Name:** List the brand name of each product exactly as it appears on the label.
14. **Product Type:** Use the following letter codes to describe the product type:
    A – Adhesives (not including industrial adhesives) – Any product specifically formulated to cause a firm attachment (adherence) by cohesion or bonding, either temporary or permanent between two surfaces.
    C – All Purpose Cleaners – Any general cleaning product that is formulated to be used on a variety of washable surfaces to perform a variety of cleaning tasks.
    D – Disinfectants – Any product which makes a disinfectant claim, i.e., use of the product is intended to destroy or irreversibly inactivate infectious or other undesirable bacteria, pathogenic fungi, or viruses on surfaces or inanimate objects, and is regulated pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). These do not include personal hygiene products.

F – Air Fresheners – Any product which is marketed for the purpose of masking or deodorizing indoor air odors. These do not include personal hygiene products.
H – Hair Sprays, Spritzes, etc. (not including foam mousses) – Any hair control, setting, or styling product dispensed from a propellant aerosol can, a mechanical pump spray container, or any other type of spray container. These do not include styling mousse products.

An insecticide is a substance or mixture of substances marketed for the purpose of preventing, destroying, or mitigating and insects, and which is regulated pursuant to FIFRA. These do not include personal hygiene products. The following are specific subcategories of insecticides:
IR – Insect Repellants

15. **Dispensing Form**: Use the following letter codes to describe the dispensing form:
    S – Solid
    L – Liquid
    A – Aerosol
    P – Pump
    O – Other (describe)
16. **Clark County Annual Sales Volume for 2003:** Based on DAQEM Survey
17. **Product Number:** Use product number assigned in Part A.
18. **Chemical Name:** List the name of all ingredients contained in the product. Use proper chemical names as defined by IUPAC (International Union of Pure and Applied Chemists) or CAS (Chemical Abstracts Service) rules of nomenclature. Please note that: *All nonactive ingredients whose weight percent in aggregate is less than 2 percent need not be identified*.
19. **CAS #:** Chemical Abstract Service Registry Number for each ingredient.
20. **Weight %:** List the amount of each ingredient contained in the product as a percentage of the total product weight.
21. **Active/Nonactive:** Indicate for each chemical compound whether it is an active or nonactive ingredient using the following letter codes:
    A – Active Ingredient
    N – Nonactive (Inert) Ingredient
22. **Propellant:** If an ingredient is used as the aerosol propellant, please be sure columns 6 through 9 are completed for this compound and also place a 'Y' in this column.

Appendix B
Survey Letters

Clark County, Nevada
Department of Air Quality and Environmental Management
Letterhead

Date

Name
Title
Company
Street
City, State Zip

Re: Request for Product Information/Usage in Clark County

Dear *Name*:

In April 2004, the U.S. Environmental Protection Agency (EPA) designated Clark County Nevada (includes the Las Vegas metropolitan area), along with hundreds of other counties around the United States, as an ozone nonattainment areas. This means that ozone levels in Clark County are higher than the EPA standard. Ozone is a substance that forms in the atmosphere photochemically from precursor emissions. These precursors include solvents or volatile organic compounds (VOCs) released into the air mainly due to evaporation. The use of paints and printing inks is one of the largest industrial sources of VOCs. However, in metropolitan areas that have little manufacturing activity, major VOC sources include the use of consumer products like hair sprays, nail polish removers, cleaning agents, deodorants, etc. Although each individual container of these products contains only a few ounces of VOCs, millions of uses each day contribute significantly to the formation of ozone.

Clark County Department of Air Quality and Environmental Management (DAQEM) requests information to quantify the VOC emissions from the use of consumer products. Once emissions from all sources like mobile sources, consumer products, industrial sources, printing companies, etc. are obtained, Clark County will develop a strategy to reduce the emissions from different source categories. DAQEM seeks data on the amount of consumer products used within Clark County, Nevada. In this regard, we request that **you provide information on the actual volume of certain products sold** in your stores in Clark County. We do not need sales dollars or unit costs for this study.

We understand that point of sale data for each store is available by product category and Universal Product Code (UPC) number for the entire year. We have selected calendar year 2003 for this evaluation. We have requested similar data from other companies to ensure that we obtain a comprehensive survey of the amount of products sold. We will compile the sales data in such a fashion that neither individual vendors nor their stores can be identified. Furthermore, we will maintain a secure data base such that neither you nor your competitors will be able to gain access to any sales volume information.

The types of products for which we need information are shown on the attached table by category. Please provide an electronic spreadsheet, preferably Microsoft Excel, showing the category, product, size, weight, and units sold for each product. If the category description does not match your product description, please correct the description and provide the requested sales data. For example, the category we refer to as "personal hygiene products" may be called or include products called "antifungal deodorant spray" in your stores. We will use the sales information, which includes the weight of the contents of the container, along with data on the VOC content of the product that we will obtain from you or the manufacturer to make our computations. Environmental regulations require manufacturers of certain products that contain hazardous substances to supply users with Material Safety Data Sheets (MSDS). Please provide a copy of the MSDS for all products sold in the categories listed in the attached table.

Please respond with this information within 30 days and send your response to MACTEC Federal Programs, Inc., 560 Herndon Parkway Suite 200, Herndon, VA 20170, Attn: Vanessa Olsen. Should you have any questions regarding the information requested, please call Mr. Douglas Toothman of MACTEC at 703.471.8383. We greatly appreciate your cooperation in improving the quality of the air in Clark County.

Sincerely,

CLARK COUNTY DEPARTMENT OF
AIR QUALITY AND ENVIRONMENTAL
MANAGEMENT

Harish S. Agarwal, P.E.
Senior Planner

Enclosures

Category	Includes	Example Products (Not All-Inclusive)
Hair Care	Color, Styling, Mousse, Spray, Conditioner, Bleach/Lightener, Growth Retardant/Inhibitor, Shine, Tonic/Restorer, Shampoo, Lice Removers, Wig Cleaners, Pet Shampoo	• White Rain Pearberry Hair Spray 7 oz. • Sun-In Super Streaks • Sally Hansen Crème Hair Bleach for Face • L'Oreal Hair Color Remover Kit • Revlon Colorstay • Citre Shine Instant Conditioner • St. Ives Hair Repair No Frizz Serum • White Rain Select Effects Leave In Conditioner • L'Oreal Casting Color Spa • Grecian Moustache & Beard Haircolor – Dark Brown • Jergens Naturally Smooth Moisturizer • Vidal Sassoon Polishing Drops • Got2B Glued • L'Oreal Kids Styling Gel • VO5 Mousse • Jheri Redding Straightening Gel • Rusk Being Slick Pomade • Minoxidil • AVO Flea & Tick Shampoo • Thermasilk Heat Activated Shampoo Daily Clarifying • Super Star Fantastic Wig Cleaner • Lice Egg Remover Combing Gel
Nail Care	Coating, Artificial Nail, Wrap, Glue Remover, Polish Thinner, and Drying Enhancer	• Sally Hansen Dries Instantly Base Coat • Sally Hansen Artificial Nail Remover • Revlon Nail Builders – Get Smoother Ridge Filler • Naturistics 60 Second Quick Dry Top Coat • L'Oreal Shock Proof Nail Enamel • Orly Smudge Fixer • Revlon Professional Quick Dry Liquid • Almay Massage & Grow Nail and Cuticle Wax • Nail Experts Liquid Silk Wrap

Category	Includes	Example Products (Not All-Inclusive)
Body Wipes	Baby Wipes, Anti-bacterial Wipes, Refreshing Body Cloths, Medicated Rectal/Vaginal Pads, Hair Removal Towelette, Hand Cleaner Wipes, Pet Shampoo Wipes	• Pampers Sensitive Touch Wipes, 72 ea. • WetOnes Antibacterial Wipes, Wild Watermelon & Ballistic Berry, 24 ea. • Shower to Shower Refreshing Body Cloths, Island Fresh 30 ea. • Tucks Hemorrhoidal Pads with Witch Hazel, 40 ea. • Petkins Doggy Wipes, pkg. of 6
Personal Foaming Products	Foaming Body Wash, Foaming Bath, Foaming Hand Cleaner, Foaming Face Wash, Anti-bacterial Foam, Pet Foaming Cleanser, Acne Wash Foaming Cleanser	• Dove Essential Nutrients Self-Foaming Cleanser 6.76 oz • Pond's Clear Solutions Deep Pore Foaming Cleanser • Vagisil Foaming Wash Fresh Clean Scent 1.6 oz • Dial Complete Foaming Hand Wash 7.5 oz
Personal Hygiene Products	Feminine Sprays, Antifungal Sprays & Liquids, Foot & Sneaker Sprays, Jock Itch Sprays	• Lotrimin AF Jock Itch Spray Powder 100g • FDS Feminine Deodorant Spray Baby Powder 1.5 oz • Tinactin Antifungal Deodorant Powder Spray 100g
Shaving Gel		• Skintimate Shave Gel Sensitive Skin 7 oz • Edge Active Care Gel Clean 7 oz • King of Shaves AlphaGel Shaving Gel Antibacterial Formula 5.95 oz
Insect Repellent (NON-Aerosol)	Insect Repellents (humans and pets)	• 10 Hour The Insect Repellent Pump 2 oz • Deep Woods Off! With Sunscreen • Coppertone-R Bug and Sun • Cutter All Family Insect Repellent Towelettes
Leather Care	Cleaner, Polishes, Conditioners, Saddle Soaps, Ball Glove Oils, Liquid Pine Tar, Dyes, Dressings	• Kiwi Leather Dye, Black • Kiwi Sport Shoe Stuff Rain and Stain • Kiwi Suede and Nubuck Cleaner • Kiwi Outdoor Mink Oil
Footwear Care Product	Cleaners, Oils, Shoe Stretch, Conditioners, Polishes, Odor Control, Saddle Soaps	• Kiwi Sport Athletic Shoe Deodorant and Sanitizing • Kiwi Leather Scuff Cover, Black

Category	Includes	Example Products (Not All-Inclusive)
Fabric or Leather Waterproofer		• Scotchgard Heavy Duty Water Repellent • Rain X Weather Guard • Kiwi Outdoor Wet Pruf
Fabric Refresher		• Febreze • Lysol Disinfectant Spray Plus Fabric Refresher • Arm & Hammer Vacuum Free Foam Carpet Deodorizer
In-dryer Fabric Care	Dryer Activated Cloths	• Dryel
Wrinkle-Releasing Spray	Wrinkle Releasing Sprays	• Downy Wrinkle Releaser, 500 mL
Anti-Static Product	Concentrates, Sprays, Floor Finishes	• Static Guard 5.5 oz • Endust for Electronics Anti-Static Cleaning and Dusting
Electronic Cleaner		• 3M 16-101 General Purpose Contact Cleaner • Endust for Electronics Floppy Drive Head Cleaner • Endust for Electronics Wipes, 70 count
Jewelry Cleaner		• Tarn-X Jewelry Cleaner
Toilet or Urinal Cleaner/Deodorizer	Bowl Cleaners, Tank Cleaners, Drop-in Cleaners, Deodorizers	• Vanish Hang-Ins • Lime A Way Toilet Bowl Cleaner • Lysol Cling Toilet Bowl Cleaner
Wood Cleaner	Cleaners, Preservatives, Build-up Removers, Polish	• Orange Glo Wood Care Kit • Mop & Glo Hard Wood Floor Cleaner

Clark County, Nevada
Department of Air Quality and Environmental Management
Letterhead

Date

Name
Title
Hotel
Street
City, State Zip

Re: Request for Consumer Products Usage and Sales Data in Clark County

Dear *Name*:

In April 2004, the U.S. Environmental Protection Agency (EPA) designated Clark County Nevada (includes the Las Vegas metropolitan area), along with hundreds of other counties around the United States, as ozone nonattainment areas. This means that ozone levels in Clark County are higher than the EPA standard. Ozone is a substance that forms in the atmosphere photochemically from precursor emissions. These precursors include solvents or volatile organic compounds (VOCs) released into the air mainly due to evaporation. The use of paints and printing inks is one of the largest industrial sources of VOCs. However, in metropolitan areas that have little manufacturing activity, major VOC sources include the use of consumer products like hair sprays, nail polish removers, cleaning agents, deodorants, etc. Although each individual container of these products has only a few ounces of VOCs, millions of uses each day contribute significantly to the formation of ozone.

Clark County Department of Air Quality and Environmental Management (DAQEM) requests information to quantify VOC emissions from the use of consumer/commercial products. Once emissions from all sources, i.e., mobile sources, consumer products, industrial sources, printing companies, etc., are obtained, Clark County will develop a strategy to reduce the emissions from different source categories. DAQEM seeks data on the amount of these products used within Clark County Nevada. In this regard, we request that **you provide information on the actual volume of certain products purchased by your hotels and used by your employees or sold to guests** in your hotels in Clark County.

We understand that such data for your hotels is available by product category and Universal Product Code (UPC) number for the entire year. We have selected calendar year 2003 for this evaluation. We have and will request similar data from other hotels and retailers to ensure that we obtain a comprehensive survey of the amount of products sold/used. We will compile the usage and sales data in such a fashion that neither individual companies nor hotels can be identified. Furthermore, we will maintain a secure data base such that neither you nor your competitors will be able to gain access to any usage or sales volume information.

The types of products for which we need information are shown on the attached table by category. Please provide an electronic spreadsheet, preferably Microsoft Excel, showing the category, product, size, weight, and units used or sold for each product. If the category description does not match your product description, please correct the description and provide the requested usage or sales data. We will use the usage and sales information, which includes the weight of the contents of the container, along with data on the VOC content of the product from you or from the manufacturer to make our computations. Environmental regulations require manufacturers of certain products that contain hazardous substances to supply users with Material Safety Data Sheets (MSDS). Please provide a copy of the MSDS for all products sold in the categories listed in the attached table.

Please respond with this information within 30 days and send your response to MACTEC Federal Programs, Inc., 560 Herndon Parkway Suite 200, Herndon, VA 20170, Attn: Vanessa Olsen. Should you have any questions regarding the information requested, please call Mr. Douglas Toothman at MACTEC, on this matter at 703.471.8383. We greatly appreciate your cooperation in improving the quality of the air in Clark County.

Sincerely,

CLARK COUNTY DEPARTMENT OF
AIR QUALITY AND ENVIRONMENTAL
MANAGEMENT

Harish S. Agarwal, P.E.
Senior Planner

Enclosures

Category	Includes	Example Products (Not All-Inclusive)
Hair Care	Color, Styling, Mousse, Spray, Conditioner, Bleach/Lightener, Growth Retardant/Inhibitor, Shine, Tonic/Restorer, Shampoo, Lice Removers, Wig Cleaners, Pet Shampoo	• White Rain Pearberry Hair Spray 7 oz. • Sun-In Super Streaks • Sally Hansen Crème Hair Bleach for Face • L'Oreal Hair Color Remover Kit • Revlon Colorstay • Citre Shine Instant Conditioner • St. Ives Hair Repair No Frizz Serum • White Rain Select Effects Leave In Conditioner • L'Oreal Casting Color Spa • Grecian Moustache & Beard Haircolor – Dark Brown • Jergens Naturally Smooth Moisturizer • Vidal Sassoon Polishing Drops • Got2B Glued • L'Oreal Kids Styling Gel • VO5 Mousse • Jheri Redding Straightening Gel • Rusk Being Slick Pomade • Minoxidil • AVO Flea & Tick Shampoo • Thermasilk Heat Activated Shampoo Daily Clarifying • Super Star Fantastic Wig Cleaner • Lice Egg Remover Combing Gel
Nail Care	Coating, Artificial Nail, Wrap, Glue Remover, Polish Thinner, and Drying Enhancer	• Sally Hansen Dries Instantly Base Coat • Sally Hansen Artificial Nail Remover • Revlon Nail Builders – Get Smoother Ridge Filler • Naturistics 60 Second Quick Dry Top Coat • L'Oreal Shock Proof Nail Enamel • Orly Smudge Fixer • Revlon Professional Quick Dry Liquid • Almay Massage & Grow Nail and Cuticle Wax • Nail Experts Liquid Silk Wrap

Category	Includes	Example Products (Not All-Inclusive)
Body Wipes	Baby Wipes, Anti-bacterial Wipes, Refreshing Body Cloths, Medicated Rectal/Vaginal Pads, Hair Removal Towelette, Hand Cleaner Wipes, Pet Shampoo Wipes	• Pampers Sensitive Touch Wipes, 72 ea. • WetOnes Antibacterial Wipes, Wild Watermelon & Ballistic Berry, 24 ea. • Shower to Shower Refreshing Body Cloths, Island Fresh 30 ea. • Tucks Hemorrhoidal Pads with Witch Hazel, 40 ea. • Petkins Doggy Wipes, pkg. of 6
Personal Foaming Products	Foaming Body Wash, Foaming Bath, Foaming Hand Cleaner, Foaming Face Wash, Anti-bacterial Foam, Pet Foaming Cleanser, Acne Wash Foaming Cleanser	• Dove Essential Nutrients Self-Foaming Cleanser 6.76 oz • Pond's Clear Solutions Deep Pore Foaming Cleanser • Vagisil Foaming Wash Fresh Clean Scent 1.6 oz • Dial Complete Foaming Hand Wash 7.5 oz
Personal Hygiene Products	Feminine Sprays, Antifungal Sprays & Liquids, Foot & Sneaker Sprays, Jock Itch Sprays	• Lotrimin AF Jock Itch Spray Powder 100g • FDS Feminine Deodorant Spray Baby Powder 1.5 oz • Tinactin Antifungal Deodorant Powder Spray 100g
Shaving Gel		• Skintimate Shave Gel Sensitive Skin 7 oz • Edge Active Care Gel Clean 7 oz • King of Shaves AlphaGel Shaving Gel Antibacterial Formula 5.95 oz
Insect Repellent (NON-Aerosol)	Insect Repellents (humans and pets)	• 10 Hour The Insect Repellent Pump 2 oz • Deep Woods Off! With Sunscreen • Coppertone-R Bug and Sun • Cutter All Family Insect Repellent Towelettes
Leather Care	Cleaner, Polishes, Conditioners, Saddle Soaps, Ball Glove Oils, Liquid Pine Tar, Dyes, Dressings	• Kiwi Leather Dye, Black • Kiwi Sport Shoe Stuff Rain and Stain • Kiwi Suede and Nubuck Cleaner • Kiwi Outdoor Mink Oil
Footwear Care Product	Cleaners, Oils, Shoe Stretch, Conditioners, Polishes, Odor Control, Saddle Soaps	• Kiwi Sport Athletic Shoe Deodorant and Sanitizing • Kiwi Leather Scuff Cover, Black

Category	Includes	Example Products (Not All-Inclusive)
Fabric or Leather Waterproofer		• Scotchgard Heavy Duty Water Repellent • Rain X Weather Guard • Kiwi Outdoor Wet Pruf
Fabric Refresher		• Febreze • Lysol Disinfectant Spray Plus Fabric Refresher • Arm & Hammer Vacuum Free Foam Carpet Deodorizer
In-dryer Fabric Care	Dryer Activated Cloths	• Dryel
Wrinkle-Releasing Spray	Wrinkle Releasing Sprays	• Downy Wrinkle Releaser, 500 mL
Anti-Static Product	Concentrates, Sprays, Floor Finishes	• Static Guard 5.5 oz • Endust for Electronics Anti-Static Cleaning and Dusting
Electronic Cleaner		• 3M 16-101 General Purpose Contact Cleaner • Endust for Electronics Floppy Drive Head Cleaner • Endust for Electronics Wipes, 70 count
Jewelry Cleaner		• Tarn-X Jewelry Cleaner
Toilet or Urinal Cleaner/Deodorizer	Bowl Cleaners, Tank Cleaners, Drop-in Cleaners, Deodorizers	• Vanish Hang-Ins • Lime A Way Toilet Bowl Cleaner • Lysol Cling Toilet Bowl Cleaner
Wood Cleaner	Cleaners, Preservatives, Build-up Removers, Polish	• Orange Glo Wood Care Kit • Mop & Glo Hard Wood Floor Cleaner

Appendix C
Database of Contacts

Company	POC	Title	Address
Sam's Club	Pam Spies	NA	608 SW 8th St., Bentonville, AR 72712
7-Eleven	Marlo Michalek	NA	2711 N. Haskell Ave, Dallas, TC 75204
Target	Kristen Knowles	NA	1000 Nicollet Mall, Mailstop 1161, Minneapolis, MN 55403
Kmart	Paul Guyardo	Dir. Of Marketing	3100 W. Big Beaver Rd., Troy, MI 48084
Vons	Jerry Scorsatto	Dir. Of Sales & Marketing	618 Michillinda Ave., Arcadia, CA 91007
Smith's	Dirk Burningham	Dir. Of Marketing	1550 S. Redwood Rd., SLC, UT 84101
Safeway	Brian C. Cornell	VP of Marketing	5918 Stoneridge Mall Rd., Pleasanton, CA 94588
Kroeger	Evan Anthony	Dir. Of Marketing	1014 Vine St., Cincinnati, OH 45202
Food 4 Less	Eddie Vasquez	NA	1100 W. Artesia Blvd., Compton, CA 90220
Raley's	Kathy Herbold	Dir. Of Marketing/Advertising	500 W. Capitol Ave., W. Sacramento, CA 95605
Ross Stores	Janet Kanios	NA	8333 Central Ave., Newark, CA 94560
Pier 1Imports	Mike Foulkes	Dir. Of Strategic Marketing	301 Commerce St., Suite 600, Ft. Worth, TX 76102
Mervyn's	Ms. Lee Walker	VP of Marketing	22301 Foothill Blvd., Hayward, CA 94501
CVS	Chris Bodine	NA	One CVS Drive, Woonsocket, RI 02895
JC Penney	Nick Bomersbach	Dir. Of Marketing	6501 Legacy Dr., Plano, TX 75024
Big A Drug Store	Dave Wright	Dir. Of Marketing	12030 S. Garfield Ave., South Gate, CA 90280
Walgreens	Doug Egan	VP of Marketing	200 Wilmot Rd., Deerfield, IL 60015
Rite Aid	John Learish	Senior VP of Marketing	30 Hunter Lane, Camp Hill, PA 17011
Longs Drugs	Todd Vasos	Dir. Of Marketing	141 N. Civic Drive, Walnut Creek, CA 94596
Dillard's	Ken Eaton	NA	1600 Cantrell Rd., Little Rock, AR 72201
Home Depot	John Costello	Exec. VP of Merchandising	455 Paces Ferry Rd., NW, Atlanta, GA 30339
Lowe's	Dale Pond	Senior VP of Merchandising	1000 Lowe's Blvd., Mooresville, NC 28117
Albertson's	Paul T. Gannon	Chief Marketing Officer	250 E. Parkcenter Blvd., Boise, ID 83706
Quick Stop	DJ Longa	Marketing	4567 Enterprise, Fremont, CA 94537
Federated Dept.	Janet E. Grove	Chair of Federal Merchandising Group	7 W. Seventh St., Cincinnati, OH 45202
May Department Stores	Mary Morgan	Store Administration	6160 Laurel Canyon Blvd., N. Hollywood, CA 91606
Walmart	Robert F. Connolly	Exec. VP of Marketing	702 SW 8th St., Bentonville, AR 72716
ACE Hardware	Lori Bossman	VP of Marketing	2200 Kensington Ct., Oakbrook, IL 60523
NY NY Hotel	Jack Stone	Dir. Of Purchasing	3799 S. Las Vegas Blvd., LV, NV 89109
Bellagio	Larryl Lamb	Dir. Of Purchasing	3600 S. Las Vegas Blvd., LV, NV 89109
Boardwalk Hotel	Joe Benson	Purchasing Manager	3750 S. Las Vegas Blvd., LV, NV 89109
Primm Valley Casino Resorts	Frank Scharadin	Dir. Of Purchasing	31700 Las Vegas Blvd., Jean, NV 89019
The Mirage	Lisanne Bogle	Dir. Of Purchasing	3400 S. Las Vegas Blvd., LV, NV 89109
TI	Kirstin Naylor	Controller	3300 S. Las Vegas Blvd., LV, NV 89109
Caesars Entertainment	Steven N. Rosen	Senior VP	3570 S. Las Vegas Blvd., LV, NV 89109
Boyd Gaming	Marianne Boyd Johnson	Vice Chairman	2950 Industrial Rd., LV, NV 89109
Saks Fifth Avenue	Vicky Forinos	Dir. Of Marketing	750 Lakeshore Pkwy, Birmingham, AL 35211
Speedee Mart	NA	NA	2980 E. Tropicana, LV, NV 89121
Short Line Express	Liz Lutz	NA	4040 N. Tenaya Way, LV, NV 89129
Amerisource Bergen Corp	Fred Stern	VP Procurement	1300 Morris Drive, Suite 100, Chesterbrook, PA 19087-5594
MGM Mirage	Mark Stolarczyk	Corp. Purchasing VP	3799 S. Las Vegas Blvd., LV, NV 89109
Mandalay Resort Group	Darlene Ghirardi	Dir. Of Purchasing	3950 S. Las Vegas Blvd., LV, NV 89119
Harrah's Corp.	Ginny Shanks	Senior VP, Acquisition Marketing	One Harrah's Court, LV, NV 89119

Appendix D
Hairspray Survey Data

MACTEC

	Are you a visitor to Las Vegas?		Do you use hairspray?		Use per day @ home	Use per day in Las Vegas
	Yes	No	Yes	No		
1	X		X		1/WK	1/WK
2	X		X		1/DAY	1/DAY
3	X			X		
4	X			X		
5	X		X		1/DAY	1/DAY
6	X			X		
7	X		X		1/WK	1/WK.
8	X			X		
9	X		X		1/DAY	1/DAY
10	X			X		
11	X			X		
12	X			X		
13	X		X		1/WK	0
14	X			X		
15	X		X		2X/DAY	1X/DAY
16	X		X		2X/WK	2X/WK
17	X		X		1X/DAY	1X/DAY
18	X		X		1/DAY	1/DAY
19	X		X		1/DAY	LESS
20	X		X		1/DAY	1/DAY
21	X		X		1/DAY	SAME
22	X		X		1/DAY	LESS
23	X		X		1/DAY	1/DAY
24	X		X		1/DAY	1/DAY
25	X		X		1/DAY	SAME
26	X		X		1/DAY	1/DAY
27	X		X		1/WK	1/WK
28	X		X		1/DAY	LESS
29	X			X		
30	X		X		1/DAY	LESS
31	X			X		
32	X		X		1/DAY	SAME
33	X			X		
34	X		X		1/DAY	2/DAY
35	X			X		
36	X		X		1/DAY	~~SAME~~ LESS
37	X		X		1/DAY	LESS
38	X			X		
39	X		X		1/DAY	SAME
40	X		X		1/DAY	LESS

MACTEC

	Are you a visitor to Vegas?		Do you use hairspray?		Use per day @ home	Use per day in Vegas
	Yes	No	Yes	No		
41	X			X		
42	X			X		
43	X		X		1/DAY	2/3 → DAY
44	X		X		1/DAY	1/DAY
45	X		X		2/DAY	2/DAY
46	X		X		1/WK	LESS.
47	X		X		2/DAY	MORE
48	X			X		
49	X			X		
50	X			X		
51	X		X		1/DAY	DON'T KNOW YET
52	X		X		3/DAY	1/DAY
53	X		X		1/DAY	1/DAY
54	X			X		
55	X		X		2X/WK	4/DAY
56	X		X		1/DAY	2/DAY
57	X		X		1/DAY	LESS
58	X		X		1/DAY	1/DAY
59		X				
60	X		X		2/WK	1/DAY
61	X		X		1/DAY	1/DAY
62	X			X		
63	X			X		
64	X			X		
65	X			X		
66	X		X		1/DAY	1/DAY
67	X		X		1/DAY	1/DAY
68	X			X		
69	X			X		
70		X				
71	X		X		1/DAY	LESS
72	X		X		1/DAY	1/DAY
73	X		X		2/DAY	1/DAY
74	X			X		
75	X		X		2/DAY	MORE
76		X				
77	X		X		2/YR	NO
78	X			X	~~2/DAY~~	~~MORE~~
79	X		X		2/DAY	MORE
80	X		X		2/DAY	2/DAY

MACTEC

	Are you a visitor to Vegas?		Do you use hairspray?		Use per day @ home	Use per day in Vegas
	Yes	No	Yes	No		
81	X			X		
82	X		X		1/DAY	1/DAY
83	X		X		1/DAY	1/DAY
84	X			X		
85	X		X		1/DAY	1/DAY
86	X		X		1/WK	0
87	X			X		
88	X		X		1/DAY	1/DAY
89	X		X		1/WK	1/DAY
90	X		X		1/DAY	1/DAY
91	X			X		
92	X			X		
93	X			X		
94		X				
95	X		X		1/DAY	1/DAY
96	X			X		
97	X			X		
98		X				
99	X		X		1/DAY	1/DAY
100	X		X		2/DAY	2/DAY
101	X			X		
102	X			X		
103	X			X		
104		X				
105	X			X		
106	X		X		1X/2 WKS	0
107	X			X		
108	X			X		
109	X			X		
110	X			X		
111	X			X		
112	X			X		
113	X		X		1/DAY	1/DAY
114	X		X		1/DAY	1/DAY
115	X			X		
116	X		X		1/DAY	1/DAY
117	X			X		
118	X			X		
119	X		X		1/DAY	1/DAY
120	X		X		1/DAY	DON'T KNOW

Appendix E
Source Category Correlation

Source Category Correlation – CARB to SCC

The SCCs required by the NIF databases are followed by the CARB categories (from Tables 7.1, 7.2, 8.1, 8.2, and 8.3) assigned to each by MACTEC.

2460110000 Personal Care Products: Hair Care Products

- Hair styling product: spray
- Shampoo
- Hair styling product: mousse
- Conditioner
- Hair color product: permanent
- Hair shine
- Hair styling product: liquid
- Hair color product: temporary
- Hair styling product: semisolid
- Bleach/lightener
- Hair color product: semipermanent
- Hair color product: demipermanent
- Hair tonic/hair restorer
- Hair styling product: solid
- Other hair care products

2460130000 Personal Care Products: Fragrance Products

- Personal fragrance

2460150000 Personal Care Products: Nail Care Products

- Nail polish
- Nail treatment product
- Nail product: drying enhancer
- Top coat
- Base coat/undercoat
- Nail polish thinner
- Artificial nail, wrap, or nail glue remover

2460190000 Personal Care Products: Miscellaneous Personal Care Products

- Shaving gel
- Personal hygiene products
- Body wipes
- Personal foaming products

2460230000 Household Products: Fabric and Carpet Care Products

- Fabric refresher

2460250000 Household Products: Waxes and Polishes

- Waxes and Polishes

2460270000 Household Products: Shoe and Leather Care Products

- Footwear care product
- Fabric or leather waterproofer
- Leather care product

2460290000 Household Products: Miscellaneous Household Products

- Toilet/urinal deodorizer
- Toilet/Urinal cleaner & deodorizer
- Toilet or urinal cleaner
- Jewelry cleaner

2460410000 Automotive Aftermarket Products: Detailing Products

- Automotive detailing products

2460420000 Automotive Aftermarket Products: Maintenance and Repair Products

- Automotive maintenance and repair

2460510000 Coatings and Related Products: Aerosol Spray Paints

- Aerosol spray paints

2460520000 Coatings and Related Products: Coating Related Products

- Aerosol coating related products

2460610000 Adhesives and Sealants: Adhesives

- Contact Adhesive

2460810000 FIFRA Related Products: Insecticides

- Insecticides
- Insect Repellent: Non-aerosol

2460820000 FIFRA Related Products: Fungicides and Nematicides

- Fungicides and nematicides

2460900000 Miscellaneous Products (Not Otherwise Covered)

- Packaged solvent
- General purpose degreaser
- Adhesive remover
- Multi-purpose remover
- Electronic cleaner
- Wood cleaner
- Solvent parts cleaner: non-aerosol
- Anti-static product
- Graffiti remover
- Miscellaneous

APPENDIX C

Clark County On-Road Mobile Source Emissions Inventory Report

ENVIRON

International Corporation | *Air Sciences*

Final Report

CLARK COUNTY ON-ROAD MOBILE SOURCE EMISSIONS

Prepared for
Clark County Department of Air Quality Management
500 South 500 S. Grand Central Parkway
Las Vegas, NV 89106

Prepared by
Alison K. Pollack
Stella Shepard
James Russell
John Grant
ENVIRON International Corporation
101 Rowland Way, Suite 220
Novato, CA 94945

May 2007

TABLE OF CONTENTS

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APPEDICES

Appendix A: MOBILE6 Input Files for the RTC TRANSCAD Network

TABLES

FIGURES

1. INTRODUCTION

This report describes the development of on-road vehicle emission inventories for Clark County, Nevada for use in State Implementation Plan (SIP) modeling performed by the Clark County Department of Air Quality and Environmental Management. The work was performed by ENVIRON with input and assistance from DAQEM staff and the Southern Nevada Regional Transportation Commission (RTC).

Emissions were estimated using the RTC's transportation modeling, ENVIRON's CONCEPT MV model, EPA's MOBILE6, and additional data from DAQEM and the Nevada Department of Transportation. Emissions were estimated for the eight vehicle classes as defined for EPA's MOBILE5 emission factor model, listed in Table 1-1. On-road emissions were estimated for 2002 and 2003 base years, and for projection years 2008, 2013, and 2018. For each year, emissions were estimated for every hour of the day, for a summer modeling episode. ENVIRON set up and populated the modeling system for DAQEM and ran the model for a few summer days; DAQEM then ran the model for all days in the episode for all modeling years.

Table 1-1. EPA MOBILE5 model vehicle classes.

Vehicle Class	MOBILE Code	Weight Description
Light-duty gasoline vehicles (passenger cars)	LDGV	Up to 6000 lb gross vehicle weight (GVW)
Light-duty gasoline trucks[1] (pick-ups, minivans, passenger vans, and sport-utility vehicles)	LDGT1	Up to 6000 lb GVW
	LDGT2	6001-8500 lb GVW
Heavy-duty gasoline vehicles	HDGV	8501 lb and higher GVW equipped with heavy-duty gasoline engines
Light-duty diesel vehicles (passenger cars)	LDDV	Up to 6000 lb GVW
Light-duty diesel trucks	LDDT	Up to 8500 lb GVW
Heavy-duty diesel vehicles	HDDV	8501 lb and higher GVW
Motorcycles	MC	

The DAQEM's modeling domain consists of four nested domains centered on the Las Vegas Valley: 1.33km grid cells, 4km, 12km, and 36km. The data and methods used to estimate emissions for the 1.33km and 4km domains are provided in this report. The DAQEM processed mobile source emissions in the 12k and 36k domains using the SMOKE emissions processing system.

Section 2 of this report provides and overview and lists the basic processing steps of the CONCEPT motor vehicle emissions model that was used to generate detailed on-road vehicle emissions. The RTC transportation modeling data that are the basis of the Las Vegas Valley on-road emissions are described in Section 3. Section 4 describes the methods, data, and assumptions used to estimate link-based vehicle emission inventories in the Las Vegas Valley. Section 5 describes the data and methods used to estimate on-road emissions in the rural areas of Clark County, and Section 6 describes the data and methods used to estimate the emissions in the 4km and larger modeling domains. A summary of the results is provided in Section 7.

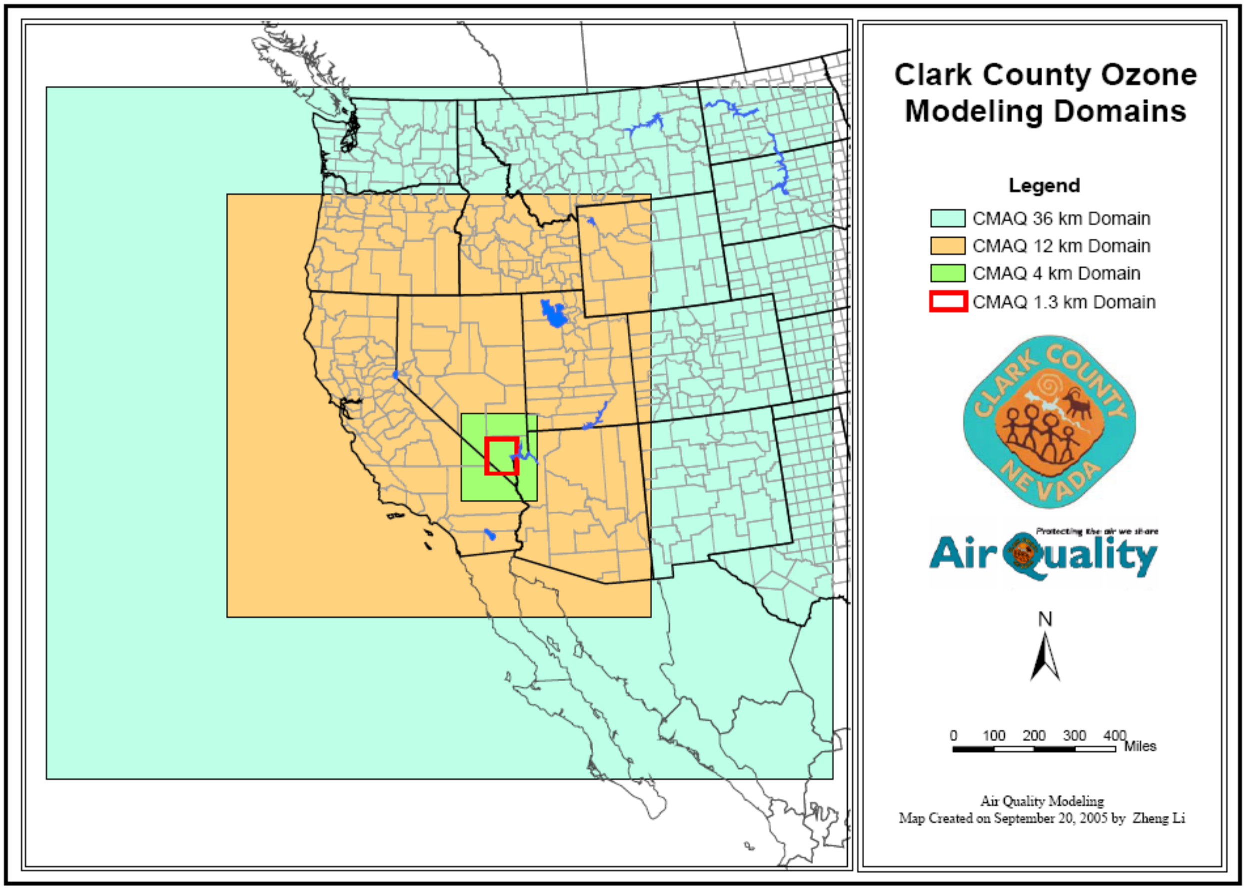


Figure 1-1. Clark County ozone modeling domains.

Table 1-2 provides a summary of the average summer day on-road emissions in the Las Vegas Valley, and outside the Valley. Despite a phenomenal increase in VMT over the 2002 to 2018 time period (7.4% per year), emissions of all ozone precursors are decreasing over that time period. This is attributable to fleet turnover – as older vehicles are scrapped, they are replaced by newer vehicles meeting much tighter federal emissions standard.

Table 1-2. Clark County Summer average day on-road emissions (TPD).

	TOG	CO	NOX
2002			
Las Vegas network	65.24	467.06	78.09
Outside network	7.89	85.06	25.03
Clark County total	73.13	552.12	103.12
2003			
Las Vegas network	64.85	456.87	77.42
Outside network	7.39	75.73	22.94
Clark County total	72.24	532.60	100.36
2008			
Las Vegas network	61.39	378.65	61.43
Outside network	5.32	48.66	14.66
Clark County total	66.71	427.31	76.08
2013			
Las Vegas network	48.46	333.25	39.52
Outside network	3.98	39.54	7.79
Clark County total	52.44	372.79	47.31
2018			
Las Vegas network	40.84	313.22	25.61
Outside network	3.36	36.67	4.63
Clark County total	44.20	349.89	30.24

2. CONCEPT MOTOR VEHICLE EMISSIONS MODEL

This section provides an overview of the CONCEPT model used to estimate the Clark County on-road emissions. In the following sections, we provide the details on the use of CONCEPT for Clark County.

CONCEPT OVERVIEW

Emissions processing models are used to generate model-ready files for air quality modeling. The major steps performed by these models are to temporally allocate the emissions (hourly), spatially allocate the hourly emissions to the grid cells in the modeling domain, and speciate the emissions (for the particular species as required by the air quality model).

The Consolidated Community Emissions Processing Tool (CONCEPT) is an emissions processing model that performs these key features. One significant feature of CONCEPT is that the motor vehicle emissions module estimates on-road emissions in a more sophisticated and detailed way than any other emissions processing system that is commonly used. DAQEM wished to estimate on-road emissions in a very detailed manner, and at the beginning of this project was considering developing software to estimate and process link-based and trip-based on-road mobile source emissions. DAQEM had specific requirements of how the mobile source emissions were to be generated and processed, and none of the existing emissions processing models at the time met the DAQEM requirements. After extensive evaluation, the DAQEM chose the CONCEPT model because of its capabilities in estimating on-road emissions. The DAQEM chose CONCEPT, in particular for its motor vehicle emissions module (CONCEPT MV) because software had been developed to interface between transportation demand models and CONCEPT, CONCEPT allows highly resolved inputs (e.g., VMT mix varying by hour of day, day of week, and month of year), CONCEPT includes vehicle trip-based emissions processing, and CONCEPT performs speed adjustments to account for congestion. As part of this project, DAQEM funded enhancements to CONCEPT MV.

The main features of the CONCEPT modeling system are as follows:

- Open Source: Written primarily in PostgreSQL, the software required for running CONCEPT is in the public domain. The model itself is GNU Public License (GPL) compliant and users are encouraged to make additions and enhancements to the modeling system.
- Transparent: The database structure of the model makes the system easy to understand, and the modeling codes themselves are extremely well documented to encourage user participation in customizing the system for specific modeling requirements.
- Quality Control: The CONCEPT model structure and implementation allows for multiple levels of QA analysis during every step of the emissions calculation process. Using the database structures, an emissions modeler can easily trace a process or facility and review the calculation procedures and assumptions for any emissions value. CONCEPT can be run with a variety of debug and QA options that control the number of intermediate tables and reports that are available for the user to review.

The core development software for the CONCEPT system is the PostgreSQL database engine, running on the Red Hat Linux operating system. In addition, the following plug-in packages, all in the public domain, are also required: perl (to facilitate data input-output from the SQL data base and data reporting); and PostGIS, GEOS and PROJ4 (to facilitate spatial processing).

The CONCEPT emissions model has been developed in a modular fashion, with five primary source category models, and a group of secondary support models that will serve each of the primary models. The major emission source categories are treated as the primary models:

- Area Source;
- Point Source;
- On-road Motor Vehicle, with EPA's MOBILE6 model;
- Non-road Motor Vehicle with the EPA's NONROAD model; and
- Biogenics.

The overall framework architecture and database design were created during the development of the point and area models. During the development process, structural requirements were refined for the unique attributes of the motor vehicle, biogenic, and NONROAD models. The supporting system modules accommodate all of the primary models, as required. The supporting modules are:

- Speciation profile development;
- Spatial surrogate development; and
- Growth & Control with Cost Analysis.

CONCEPT MV code, User's Guide, and related documentation are available on the CONCEPT web site, http://www.conceptmodel.org/.

ESTIMATION OF ON-ROAD EMISSIONS USING CONCEPT MV

The CONCEPT MV emissions model estimates and grids link-level emissions using the output from Transportation Demand Models (TDMs). The TDMs typically provide VMT or volume for multi-hour periods, and CONCEPT uses temporal allocation factors and VMT mix fractions to estimate hourly emissions for each vehicle class for each roadway type.

EPA's MOBILE6 model is executed within CONCEPT to generate the g/mile (for running emissions) and gram/trip (for trip start and trip ends) emission factors. The emission factors depend on meteorological data (temperature and humidity), which are obtained from MM5 meteorological modeling runs, for every grid cell in the modeling domain. CONCEPT then estimates emissions for each emissions mode by multiplying the activity data (VMT or trips by vehicle class) by the appropriate MOBILE6 emission factors. CONCEPT then speciates the emissions as required for input to an air quality model. The result is an hourly, gridded, speciated inventory ready for input to CMAQ or CAMx air quality modeling.

Figure 2-1 shows a flow chart of the data inputs and processing steps for generating on-road vehicle emissions within CONCEPT. The required data and CONCEPT processing are described below.

Processing of Transportation Demand Modeling (TDM) Data for Input to CONCEPT MV

Transportation demand models (TDMs) are used by transportation planning agencies to model transportation networks in local areas, and to project future transportation needs. TDMs work with links in a roadway network. A link is a section of roadway, e.g. from one freeway interchange to the next, or a short local road. For each link, transportation planners estimate the traffic volume and speed, among other factors. The development of TDMs for a local area typically includes the use of travel surveys (in which drivers report all travel and trips for a week or more) and also data from tube and or in-road traffic counters.

Because there are several transportation models in use, all with different requirements and inputs/outputs, ENVIRON developed the TDM Transformation Tool, or T3, to process and provide a conduit from the projections of traffic demand modelers regarding vehicle types, road networks, and vehicle activity to the activity data and file formats required by CONCEPT MV. The primary goals of T3 are to provide an easy mechanism for incorporating TDM model outputs in as “raw” a format as possible, while simultaneously providing a great degree of flexibility in representing the TDM projections in terms acceptable to most air quality models.

To maximize the availability (and thus utility) of T3, it was written in PostgreSQL and perl, which are both open source and freely available. The programming approach followed the community model embodied in the CONCEPT model, allowing emissions modelers to download, use, modify, and contribute new functionality to T3 freely. T3 operates on Windows, Linux, and other UNIX platforms and is written in a modular fashion to encourage community contributions to the source base.

There are three principal types of data that are typically available from transportation modeling:

- Link characteristics,
- Link traffic volumes, and
- Vehicle trips by traffic analysis zone (TAZ).

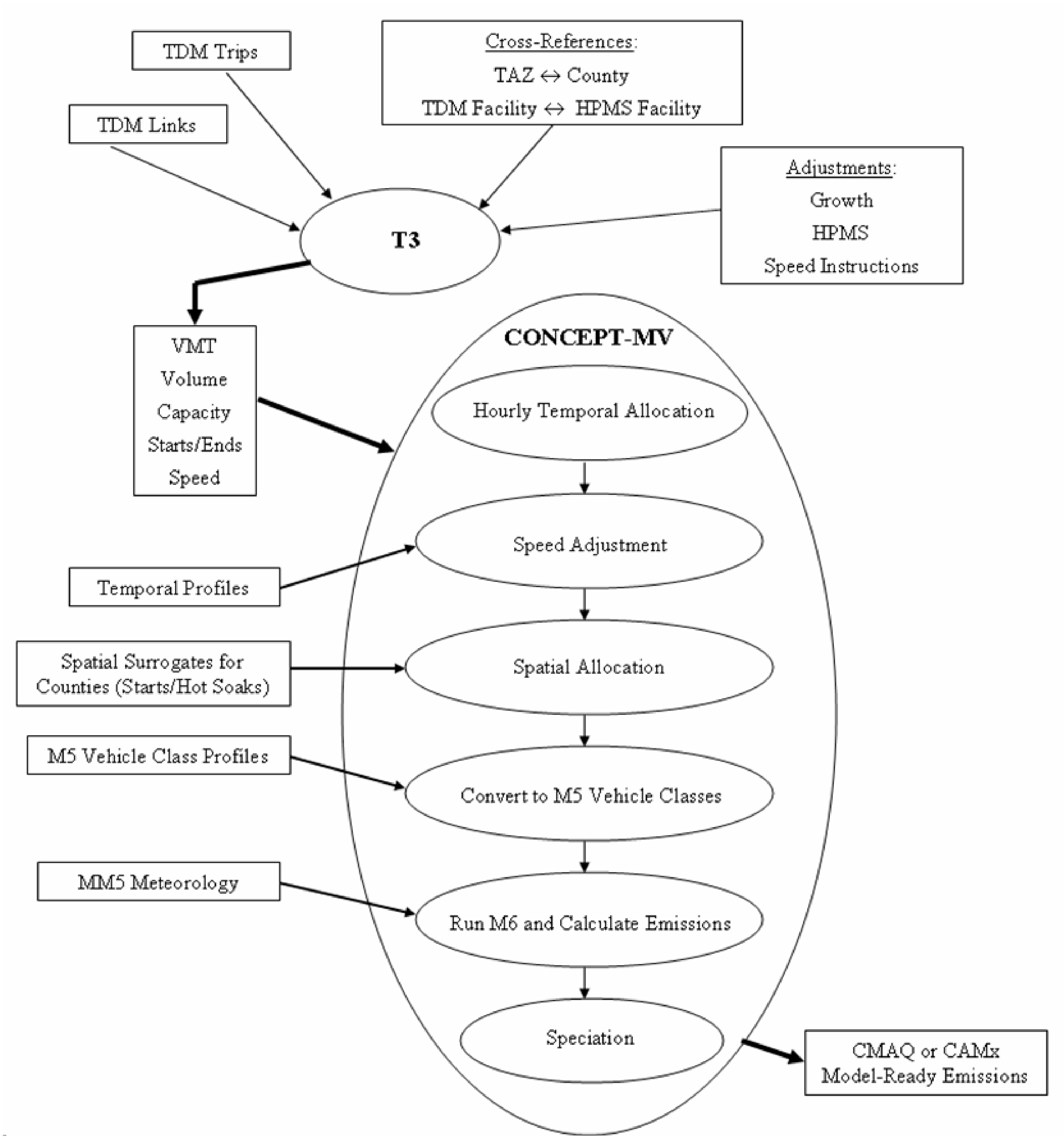


Figure 2-1. T3/CONCEPT MV flow chart.

Link-level characteristics include descriptive statistics about each roadway link in a network. These characteristics include variables such as: number of lanes, posted speed limit, direction, link capacity, width, length, and coordinates of the two end points of the link. The traffic volume data are generally given for specific time periods and for a specific type of day (average day in the year, average weekday, average weekend day). Many networks do not estimate trip data; those that do generally describe vehicle trips in terms of trips to and from each Traffic Analysis Zone (TAZ).

T3 reads the output from the different formats of data provided by the transportation modeling organizations, applies the various transformations permitted by the tool to convert the TDM data to emissions-modeling terms, and outputs the data in a format required for CONCEPT MV (RPO Data Exchange Protocol, DEP).

The TDM vehicle classification information is passed from T3 to CONCEPT with a cross-reference from the TDM classes to the CONCEPT classes, and CONCEPT conducts the necessary disaggregation from TDM vehicle classes to CONCEPT vehicle classes. The average speed and roadway classification must come from T3. Average speeds by link may be provided as actual TDM projected speeds, post-processed hourly speeds, or instructions for estimating hourly speeds from hourly volume/capacity ratios. Finally, the location of each link must be known in order to place the emissions from that link within the CONCEPT modeling domain.

The minimum required link characteristic data required are:

- endpoint coordinates and the coordinate projection definition,
- average speed or speed adjustment instructions,
- volume and vehicle miles traveled, and
- facility class (including area type).

Vehicle trips data are used by CONCEPT to calculate start and hot soak emissions. If trips data are not available, the default number of trips per vehicle generated by MOBILE6 (represented by the gram/mile start emission factors) is used to estimate emissions from these modes. The number of vehicle origin trips is reported by Traffic Analysis Zone (TAZ). The vehicle origin trips are treated as vehicle starts, and the start emissions are calculated inside CONCEPT by multiplying the grams of emissions per start by the start count in each area. Vehicle destination trips, if provided, are used to estimate hot soak emissions; if only trip starts are provided then they are used to estimate both emissions modes.

CONCEPT MV Emissions Estimation Process

The CONCEPT MV model combines vehicle activity data (VMT and vehicle trips) with motor vehicle emission factors derived from the EPA MOBILE6 model to generate gridded hourly model-ready emissions estimates. While the mathematics of combining the MOBILE6 emissions factors with the activity data are relatively straightforward, running the MOBILE6 model is generally time-consuming. CONCEPT MV is optimized for generating a large matrix (lookup table) of MOBILE6 emission factors for different vehicle classes, speeds, and meteorological conditions.

Vehicle activity data for CONCEPT comes primarily from T3 as described above. The data are typically provided for generalized time periods (average day, annual average, or partial day periods) and are temporally allocated to hourly values for the CONCEPT scenario period. In addition, the activity data are spatially allocated to the model grid since the MOBILE6 emission factors are generated by grid cell using the gridded meteorological data.

CONCEPT also reads speed data from the input files, and accepts a variety of instructions for adjusting speeds using volume delay functions. Inputs may specify a Bureau of Public Roads (BPR) style adjustment curve, or a detailed lookup table of adjustments. The curve coefficients and adjustment factors may vary by network link, speed, and volume-capacity ratio, providing a great deal of flexibility in how speeds are calculated.

The steps in CONCEPT MV that are followed to estimate model-ready emissions using the TDM data are as follows:

1. Input QA

   CONCEPT imports VMT, trips, volumes, network capacity, speeds, network definition, speed adjustments, and meteorological data and performs QA checks. CONCEPT generates both summary and error reports.

2. Temporal Allocation

   TDM data are typically provided for multi-hour periods, e.g., annual average day, or am peak/pm peak/off-peak. CONCEPT uses total-volume hourly profiles to split the multi-hour volumes to hourly volumes per link. The total volume temporal profiles are specified by State, roadway type, hour of day, day of week, and month. Temporal allocation is applied to the VMT, volume, capacity, and trips data. The profiles are typically determined from analyses of traffic counter data available from State Departments of Transportation (DOT) and/or local transportation planning agencies. The development of temporal profiles for the Clark County modeling is described in Section 4 of this report.

3. Speed Adjustment

   If the user has indicated that speed adjustments are to be applied, CONCEPT calculates the hourly volume-capacity ratios and applies appropriate adjustments to the free-flow speeds for each link to estimate hourly actual speeds. Some networks provide these data as output from their TDM or TDM post-processors, in which case no speed adjustments are performed.

4. Spatial Allocation

   MOBILE6 is executed using gridded meteorological data from MM5 modeling, so the activity data must be spatially allocated prior to determining the required MOBILE6 runs. The link-based VMT data are spatially allocated using an overlay of the link network on the model grid. County-based VMT, and TAZ/county based trip data, are typically allocated to the model grid using spatial surrogates.

5. Application of VMT Mix Profiles

   VMT data are split by the MOBILE6 vehicle classes as input to CONCEPT. The vehicle classes are converted to match the eight MOBILE5 vehicle classes used in CONCEPT using vehicle mix profiles provided as input to CONCEPT. The vehicle mix profiles vary by roadway type, month, day of week, and time of day. VMT mix profiles developed for Clark County from Clark County traffic monitoring data are described and shown in Section 4.

6. Define Required MOBILE6 Runs

   MOBILE6 is run for each combination of representative county, minimum and maximum (min/max) temperature combination, calendar year, season (January or July), roadway type, and speed bin. The min/max temperature combinations use a user-defined tolerance level so that similar temperature ranges are considered equal. For example, if the user defines 5 ºF as the tolerance level, a 52 ºF – 74 ºF range would be considered equal to a 54 ºF – 71 ºC range. Also, since the MOBILE6 model is not sensitive to specific dates, each model day is not treated differently as long as the temperature range is handled (the calendar year and season are handled in separate runs for CONCEPT model periods that span years or seasons). For each group of grid cells that fall into the same group by representative county, temperature range, year, and season, the actual roadway types present in those grid cells are examined to determine if both Freeways and Arterials need to be run in MOBILE6. The speeds for which the model is run are also defined with speed bins in the user input. Finally, the MOBILE6 model is run using a single set of 24 hourly values for temperature and relative humidity for each group of grid cells; the values are taken from one selected grid cell within the group.

7. Execute MOBILE6

   MOBILE6 is executed with the database output; CONCEPT MV uses a customized version of MOBILE6 that includes options for summarizing the database output across model years within each vehicle class, and across the detailed MOBILE6 vehicle classes (into the eight MOBILE5 vehicle classes). This significantly reduces both the size of the database files, and also processing time.

8. Combine Activity Data and Emission Factors

   Generally speaking, for each hour of each episode day, for each link in each grid cell, CONCEPT uses the grid cell ID, county, temperature increase bin, road type, and speed to determine the correct emission factor for each vehicle class, pollutant and (non-start) emission mode. Emissions for each vehicle class, emission type, and pollutant are estimated as the product of the emission factor and the VMT on that link associated with the vehicle class. This applies to running exhaust, running losses, resting losses, particulate emissions from brake and tire wear, and diurnal emissions. For start emissions and hot soak emissions, the number of trips allocated to a grid cell for each hour is combined with a grams per start emission factor associated with that grid cell and hour (if trips data are provided, else MOBILE6 g/mile emission factors are used). Start emissions are only calculated for light-duty vehicles.

9. Speciate the Emissions

   CONCEPT MV uses the same logic as other emissions source modules in CONCEPT to apply the appropriate speciation profiles by pollutant to generate the speciated emissions. The main difference in the MV model is the inclusion of the emission mode in the definition of which speciation profile to use for each pollutant.

3. LAS VEGAS VALLEY TRANSPORTATION MODELING

Link-level emissions were estimated for the Las Vegas Valley using transportation demand modeling (TDM) and related data provided by the Regional Transportation Commission of Southern Nevada (RTC). This section describes the TDM and related data and how they were used in the emissions modeling.

LAS VEGAS VALLEY TRANSPORTATION DEMAND MODELING

The transportation demand modeling (TDM) software used by the RTC is TransCAD. Staff at the RTC provided TransCAD data including link-level volumes (number of vehicles on each link), link lengths, roadway type for each link, trip starts (origin) and ends (destination) by Traffic Analysis Zone (TAZ), and intrazonal trips. VMT for each link was calculated as the product of the link length and volume.

The RTC TransCAD modeling is for an average weekday; weekend days are not modeled. The TransCAD model output provided included link-level volumes and trip origins and destinations for seven time periods: midnight - 7am, 7am- 9am, 9am – 2pm, 2pm – 4pm, 4pm – 6pm, 6pm – 8pm, and 8pm - midnight. Link volumes were provided as a total for all vehicle classes. As described in Section 4, the CONCEPT model was used to allocate the volumes for the seven time periods into the 24 hours for each day modeled, and also to disaggregate the total VMT into VMT by vehicle class.

The TransCAD output includes a roadway type designation for each link. The roadway types in the modeling are: interstate, other expressway/freeway, ramp, major arterial, minor arterial, collector, local, centroid connector, and external connector. The external connectors are links with traffic that to and from far outside the Las Vegas Valley. These external connectors were clipped at the TransCAD boundary (using Geographical Information System, or GIS, software); the length of the clipped link was calculated and as a result the VMT on these links were were adjusted to represent only that portion of the external connectors within the TransCAD boundary.

TransCAD modeling data were provided for 2002, 2003, 2008, 2013, and 2018. Figure 3-1 is a map of the RTC TransCAD network for the Las Vegas Valley for 2018; the changes in the network map from year to year are mostly in the outskirts, with additional roadways in the future years. The TransCAD network included about 16,500 links in 2002, growing to about 22,000 links in 2018.

Figure 3-2 shows a map of the RTC network with the most congested roadways highlighted. The most congested segments are found along I-15 and Las Vegas Boulevard through the urban core and U.S. 95 from the curve at Rainbow Boulevard through its interchange with I-15 (RTC, 2006). When these roadways are congested, there are more vehicles per mile traveling at low speeds, resulting in higher emissions.

For each year, trip starts and trip ends were provided for each of about 1200 TAZs. There were about 39,000 trip starts and ends in 2002, growing to about 74,000 trip starts and ends in 2018. Figure 3-3 shows a map of the TAZs in the RTC TransCAD modeling for the Las Vegas Valley.

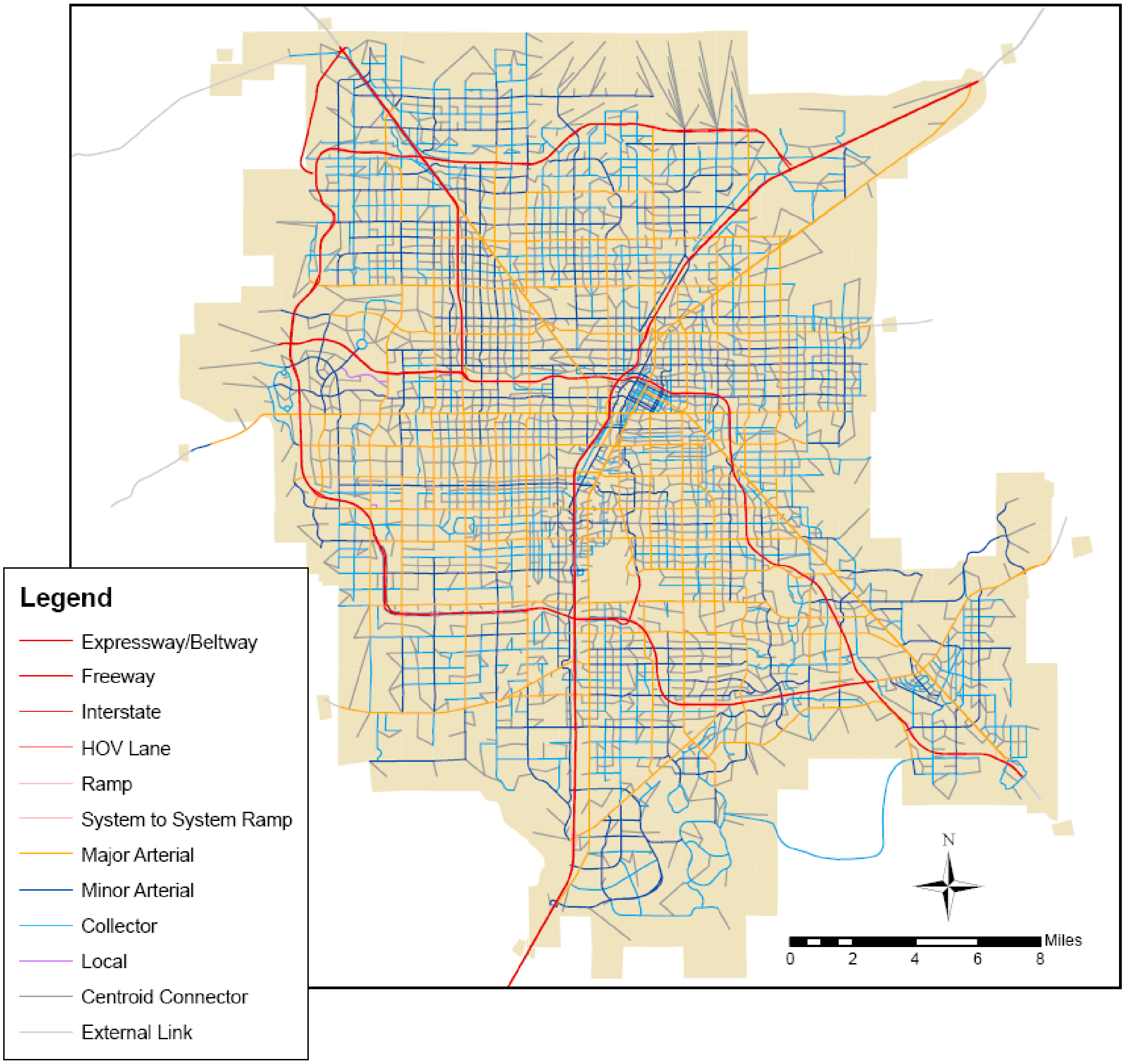


Figure 3-1. Las Vegas Valley transportation network. (Tan shading represents the area covered by the RTC traffic analysis zones.)

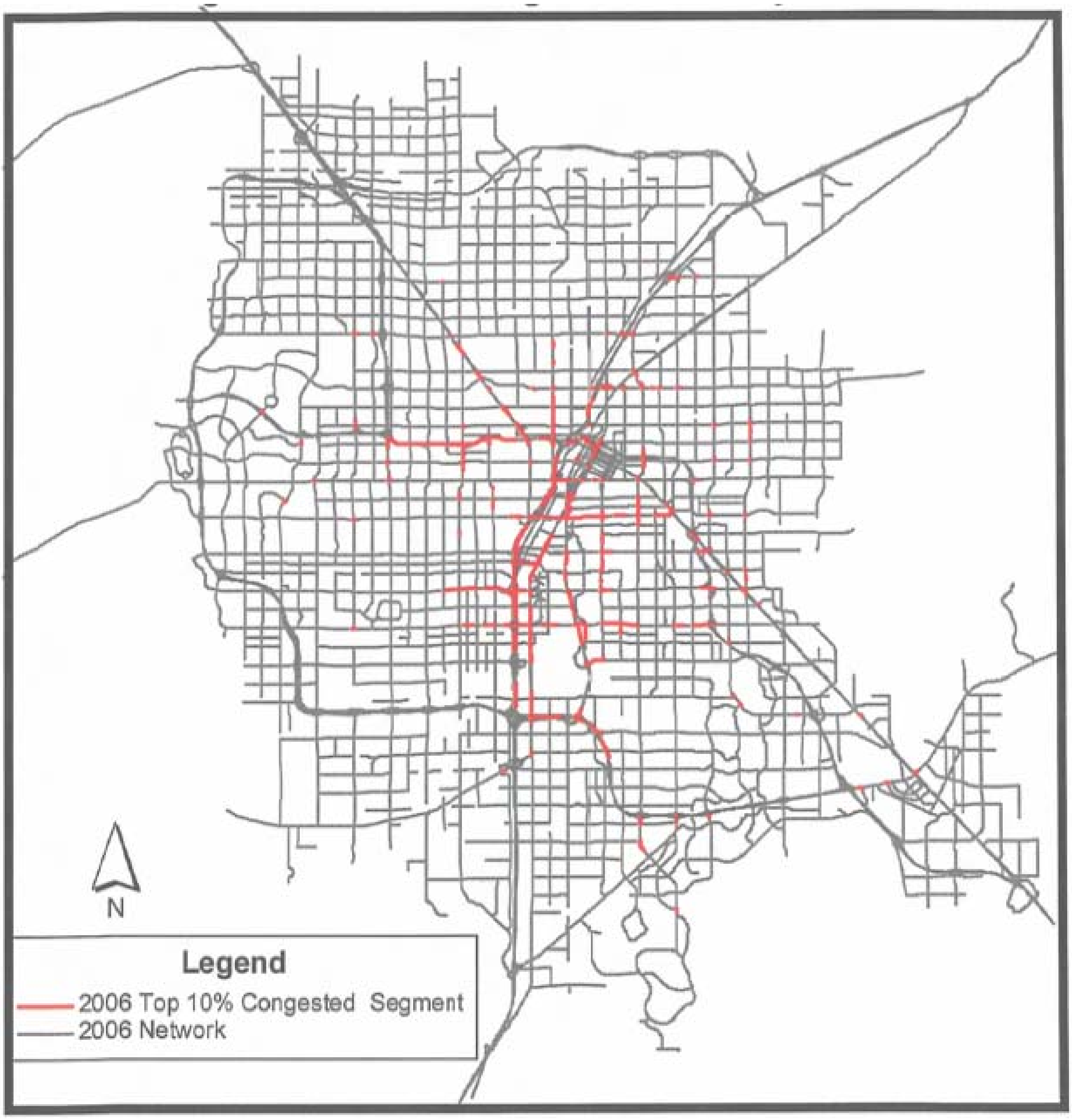


Figure 3-2. Las Vegas Valley transportation network, most congested roadways. Source: RTC(2006)

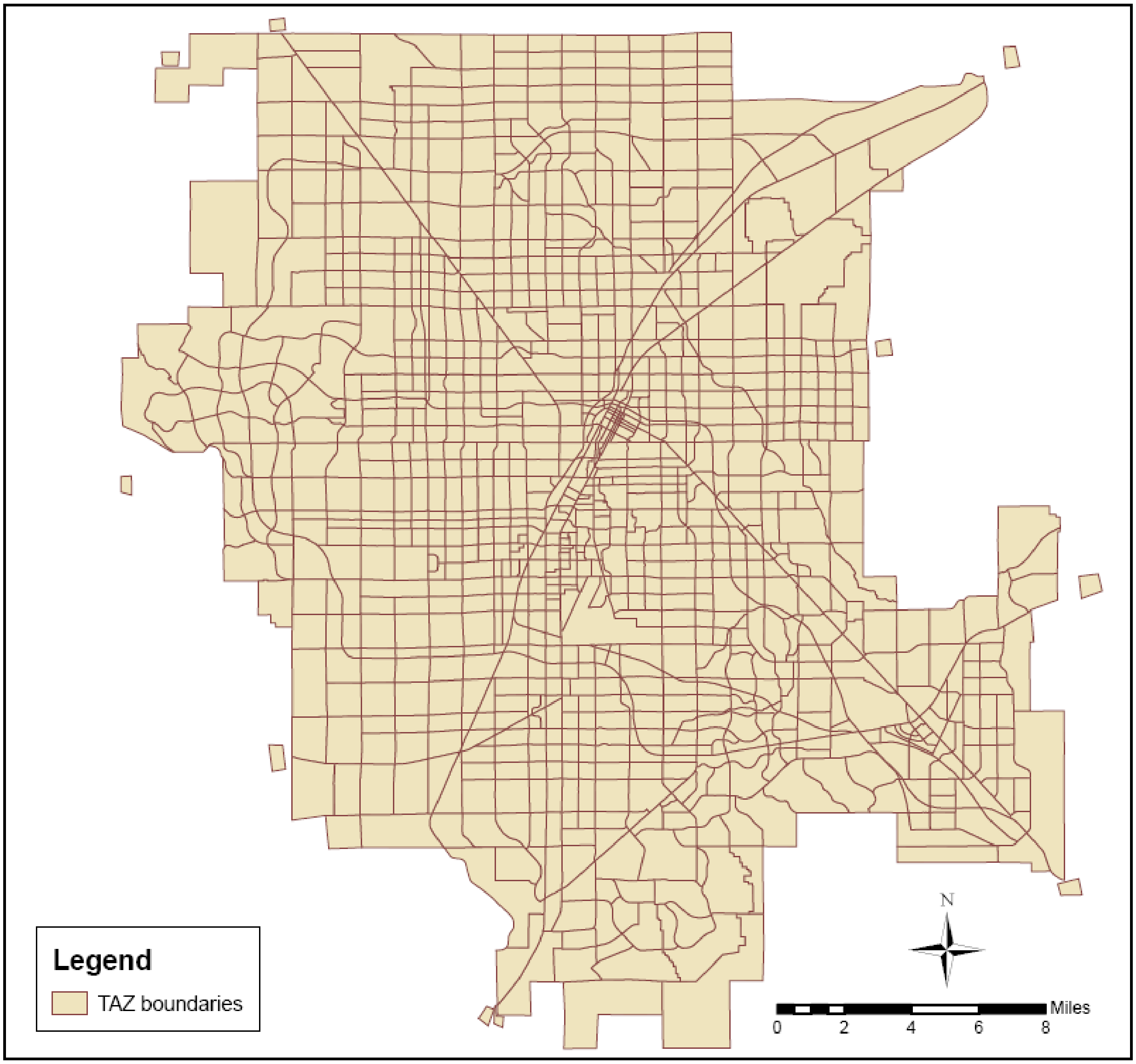


Figure 3-3. Las Vegas transportation model Traffic Analysis Zones (TAZ).

VMT ADJUSTMENTS

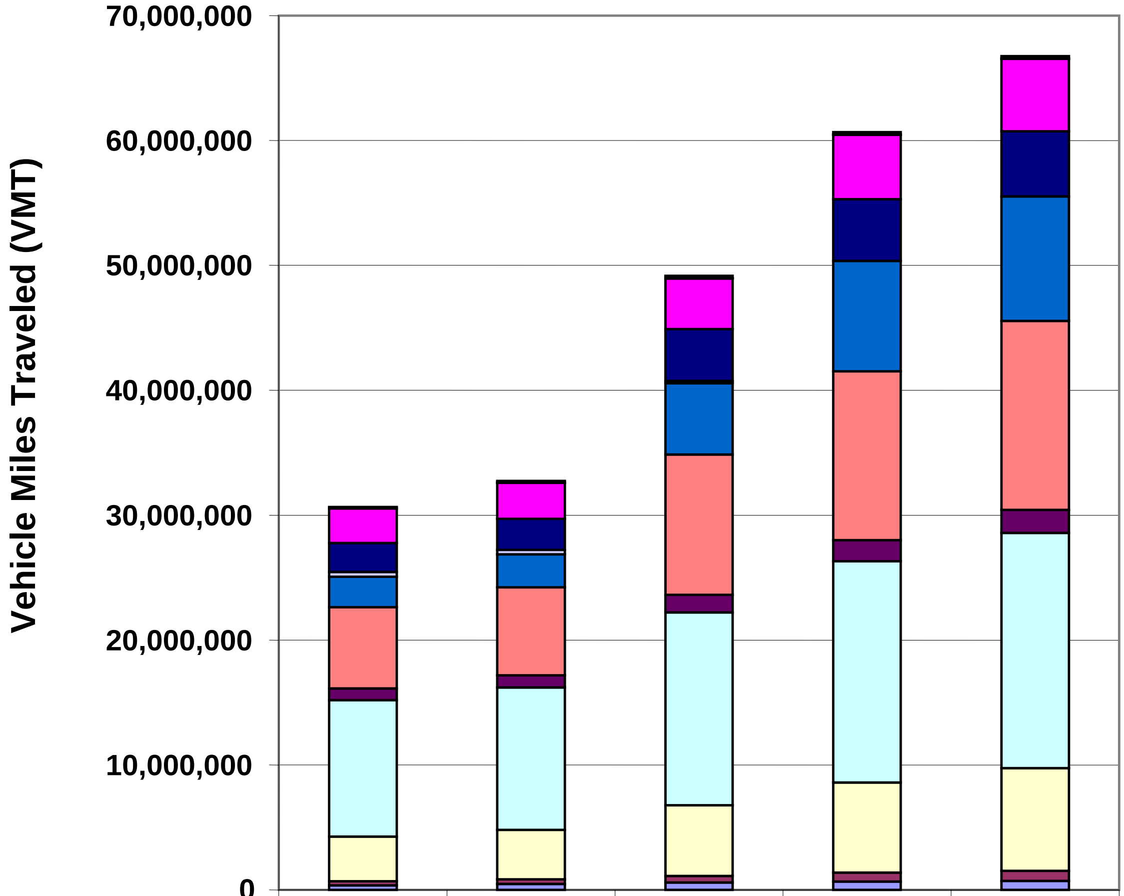
Three types of VMT adjustments were applied as provided by the RTC. The first adjustment was for matching the link volumes to observed traffic counts by facility type. These adjustment vary by facility type, as shown in Table 3-1, and the same adjustments per facility type were used for all years modeled. The second adjustment was to bring the total volume into agreement with the VMT reported through the Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS). The HPMS adjustment was an increase of 6.3% applied to all roadways types for all years modeled.

Table 3-1. Adjustment factors to observed traffic counts by facility type.

RTC Facility Type	Count Adjustment
External links	0.9102
System to System Ramp	1.4572
Minor Arterial	0.9774
Major Arterial	0.9468
Service Ramps	1.0633
Interstates	1.0043
Freeways	1.1169
Beltways, expressways	0.9272
Collectors	1.1742
Centroid	1.1742
Other Local	1.1742

The last adjustment was a transit adjustment, a small increase in VMT to account for public transit activity not included in the RTC TransCAD network modeling. This adjustment varies by year, from about 0.3% to about 0.4%.

Figure 3-4 shows the final VMT, after all adjustments, by roadway type and modeling year for the Las Vegas Valley. Las Vegas continues to be one of the fastest growing urban areas in the country. The estimated average increase from 2002 to 2018 is 7.4% per year, as compared to typical growth rates of about 2% per year in most urban areas.



	2002	2003	2008	2013	2018
Transit	105,840	105,840	196,700	196,700	197,800
Other Local	0	19,928	19,057	19,679	20,336
Centroid	2,777,176	2,905,699	4,062,369	5,165,384	5,796,599
Collectors	2,313,747	2,464,581	4,130,786	4,923,838	5,225,819
Beltways, expressways	389,168	372,648	195,866	5,033	7,949
Freeways	2,428,797	2,640,707	5,710,605	8,858,482	9,974,244
Interstates	6,502,639	7,037,621	11,238,688	13,496,565	15,115,605
Service Ramps	948,768	967,574	1,394,653	1,688,133	1,828,152
Major Arterial	10,923,130	11,416,875	15,452,231	17,740,006	18,829,046
Minor Arterial	3,567,676	3,966,191	5,650,060	7,204,914	8,236,161
System to System Ramp	349,345	358,934	528,990	718,313	805,537
External links	346,495	467,769	587,918	659,935	719,134
Total	30,652,781	32,724,367	49,167,923	60,676,982	66,756,382

Figure 3-4. Las Vegas Valley adjusted vehicle miles traveled by roadway type, 2002-2018.

4. CONCEPT MODELING TO ESTIMATE LINK-BASED EMISSIONS

The methods that CONCEPT uses to estimate link-based emissions have been described in Section 2. In this section we provide information on how the CONCEPT model was used to estimate link-based emissions for the Las Vegas Valley. Data and assumptions used for all of the inputs required by CONCEPT are provided. In addition to the estimating the link-based emissions for RTC Las Vegas Valley Transportation network, CONCEPT was also used to estimate link-based emissions for Interstate 15 to the California/Nevada border, and a description of the VMT for I15 and temporal profiles developed specifically for traffic on I15 are described in this section.

MOBILE6 INPUTS

As described in Section 2, CONCEPT uses EPA's MOBILE6 model to estimate gram per mile and gram per trip emission factors. The MOBILE6 input files used in the modeling were provided by the Clark County Department of Air Quality and Environmental Management (DAQEM). In 2002 and 2003, the Las Vegas Valley had an annual vehicle inspection and maintenance program, and lower gasoline fuel sulfur (60 ppm) than national average. In 2008 and later, both gasoline and diesel fuel sulfur levels are required to meet EPA requirements for low sulfur, and the Las Vegas Valley will have in place an on-board diagnostics (OBD) check program. The MOBILE6 input files for 2002/2003 and for 2008 and later are provided in Appendix A, along with supporting files.

One of the supporting files for MOBILE6 is the hourly distribution of vehicle trip starts. The DAQEM has developed their own trip starts distributions from RTC modeling, one for weekdays and one for weekends. These start distributions, shown in Figure 4-1, were used in the CONCEPT modeling to derive hourly trip starts and ends.

CONCEPT TEMPERATURE AND SPEED BINS

As described in Section 2, CONCEPT runs MOBILE6 for each combination of roadway type, speed, and minimum/maximum daily temperature after the link VMT have been gridded. MOBILE6 emission factors are temperature-dependent, especially for VOC emissions (see e.g., Giannelli et al., 2002). In running CONCEPT, the user specifies temperature bins, and minimum/maximum temperature combinations within the same bin are considered equivalent. One MOBILE6 run is made to represent all combinations in that bin. For example, if the user defines 5ºF as the tolerance level, a 52ºF – 74ºF range would be considered equal to a 54ºF – 71ºF range and one MOBILE6 run would be used to estimate the emissions for both. The tradeoff is that smaller bin sizes more accurately reflect the MOBILE6 dependence of emissions on temperature, but with a computing penalty because the number of MOBILE6 runs and therefore CONCEPT processing time is increased. Sensitivity runs were performed to determine temperature bins that were small enough to capture the temperature effects on emissions. For the Clark County CONCEPT modeling, the temperature bins used were every 5°F up to 90°F, 2°F from 90°F to 110°F, and every 5°F deg above 110°F.

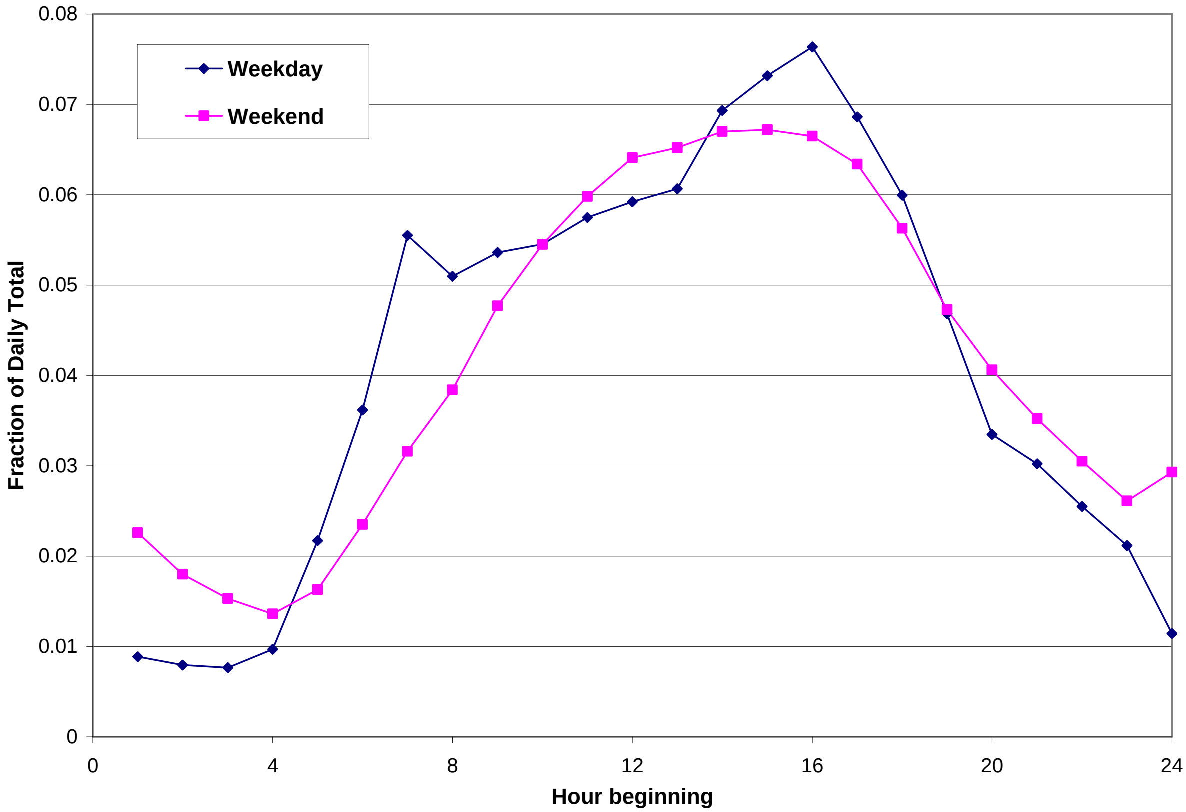


Figure 4-1. Hourly weekday and weekend starts distributions.

MOBILE6 emission factors are also very sensitive to speeds, especially at very low speeds (below 20 mph) and very high speeds (above 60 mph) (Giannelli et al., 2002). The speeds for which the model is run are also defined with speed bins in the user input. Again there is a tradeoff with smaller speed bins more accurately reflecting MOBILE6 emission factor variation with speed but at a penalty of increased computing time. Sensitivity runs performed with different speed bins were used to determine the speed bins for the RTC network modeling – every 5 mph.

CONCEPT SPEED ADJUSTMENTS

The speeds in the RTC TransCAD modeling are free-flow speeds, not congested speeds. An adjustment must therefore be made to take into account congestion and to reduce the speeds accordingly. For each link for each time period, the RTC TransCAD model provides the link capacity and volume. CONCEPT uses temporal profiles (described below) to take the period capacities and volumes and allocate them to the hours in each period, and then performs a speed adjustment using the volume to capacity (V/C) ratio for each hour.

The speed adjustment is done using the standard Bureau of Public Roads (BPR) curve:

$$S_a = \frac{S_{ff}}{1 + \left[A * \left(V/C \right)^B \right]}$$

where:

S_a = adjusted link speed (mph)

S_{ff} = reported link free flow speed (mph)

V = total link volume (vehicles OR vehicles per hour)

C = total link capacity (vehicles OR vehicles per hour)

For freeways, interstates, system ramps, and expressways,

A = 0.66 B = 7.2

For major arterials, minor arterials, collectors, ramps, and other,

A = 0.76 B = 5.9

Per discussion with the RTC and DAQEM, the volume to capacity ratio was capped at 1.25.

In the transportation modeling community, the BPR curve is generally regarded as an inaccurate speed adjustment, especially during congested traffic times when volume to capacity ratios are close to one. In addition, the transportation model roadway capacities may be overstated, as they are generally representative of the maximum volume that can be accommodated in a 15-minute interval, rather than for an hour for each hour of the day. Some evaluation of the TransCAD roadway capacities was performed, and alternative speed adjustment approaches were evaluated (e.g., Akcelik, 1991), but there was insufficient time to perform a thorough evaluation of alternative speed adjustments and modeled capacities and then implement more sophisticated speed processor in CONCEPT in order to complete the modeling work on time. Therefore, a second speed adjustment was applied to the BPR-adjusted speeds based on roadway speeds used by EPA in and the Western Regional Air Partnership (WRAP). This second adjustment was a scaling factor that was determined so that the resulting speeds being fed into the MOBILE6 model were on average the default speeds used in EPA's National Emission Inventory (Pechan and Associates, 2004) and in WRAP mobile source modeling. The effect of this scaling factor was an increase in the speeds for interstate roadway links, and a decrease in BPR-adjusted speeds for all other roadway types; these adjusted speeds were close to the speeds from the Akcelik method. DAQEM plans to work with transportation modelers in performing further evaluation of several alternative speed processors in the future.

TOTAL VOLUME TEMPORAL PROFILES

As described in Section 2, CONCEPT uses traffic volume temporal profiles to disaggregate the volumes for the seven multi-hour time periods in the RTC TDM modeling to an hourly basis. These temporal profiles were derived from analysis of Clark County traffic counter data. The volume profiles are the hourly fraction of the total vehicle volume by HPMS roadway type, month, and day of week. There are 12 HPMS roadway types (not including ramps) * 12 months * 7 days of the week, for a total of 1008 hourly profiles. In each of these profiles, 24 hourly fractions sum to 1, where each fraction corresponds to the fraction of the total volume occurring during that hour.

Nevada Department of Transportation (NDOT) traffic counter data for Clark County were used to generate the temporal profiles. NDOT provided 2003 and 2004 data from 90 continuous observation monitoring sites. The temporal profiles developed from this database were used for all modeling years. The temporal profiles were developed using only monitor-days with full 24 hours of data; incomplete days were dropped.

The NDOT data included both urban and rural monitoring sites. The temporal profiles developed from the urban monitors were used for all roads within the RTC network, and the profiles developed from rural monitors were used in the emissions modeling for the portion of Clark County that is outside the RTC network (as described in Section 5).
Sufficient data were available to calculate total volume profiles for each day of week and month of year for all roadway types for which there were monitors. There was no traffic monitoring data for Urban Collector and Urban Local roadways, and the profiles developed for Urban Minor Arterials were used for these lesser roads. Likewise, the temporal profiles developed for Rural Major Collectors were applied to the two lower classes of Rural Minor Collector and Rural Local.

Figure 4-2 shows an example hourly total volume profile, for urban freeways and expressways. Diurnal profiles are shown for the seven days of the week, for each of the twelve months. The typical urban traffic profile of a morning and afternoon peak can be seen on each of the weekdays, and a single peak on both weekend days. Figure 4-3 shows an example daily total volume profile for the same roadway classification. The plot shows, as expected, lower traffic volumes on Saturdays, and even lower volumes on Sundays. Figure 4-4 shows the monthly total volume profiles for all roadways and for the I15 monitor at the California/Nevada border (discussed below). These monthly profiles show some irregularities in the non-summer months. If annual modeling were to be performed, these irregularities would be smoothed out by combining monitoring data across non-summer months, but these changes were not made since the profiles were to be used for summer modeling only.

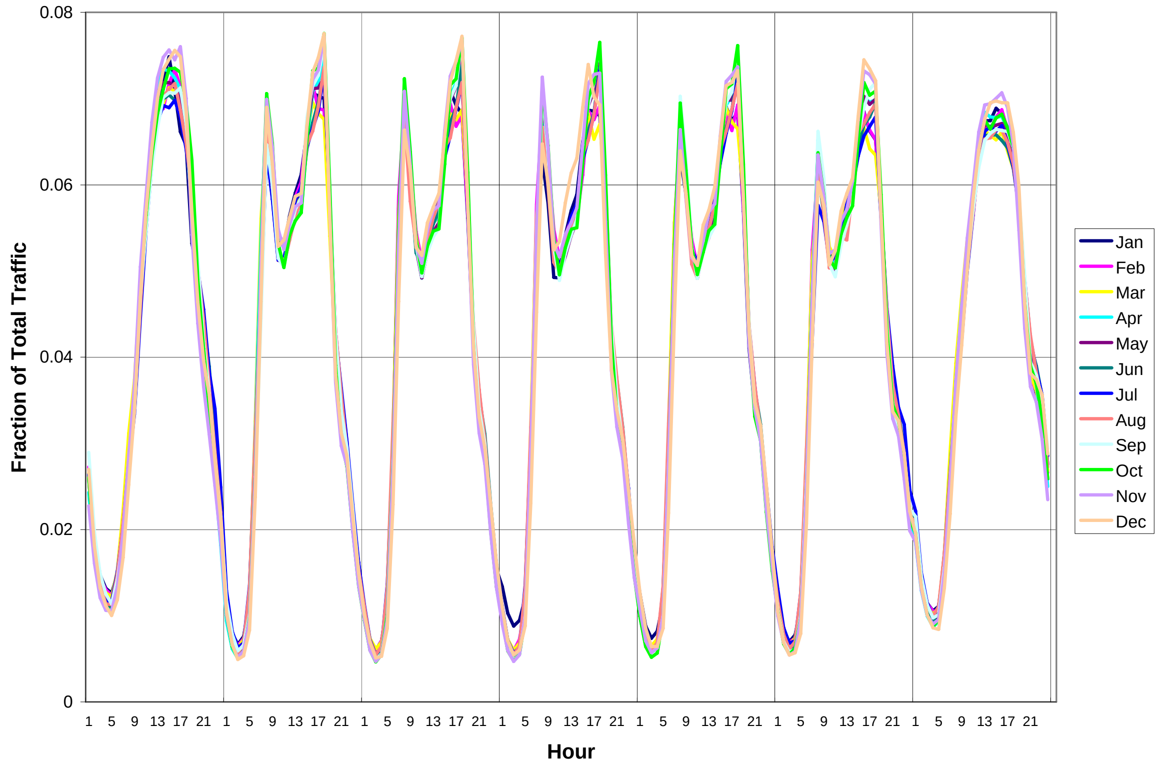


Figure 4-2. Example hourly total volume profile – Clark County urban freeways and expressways, Sunday through Saturday.

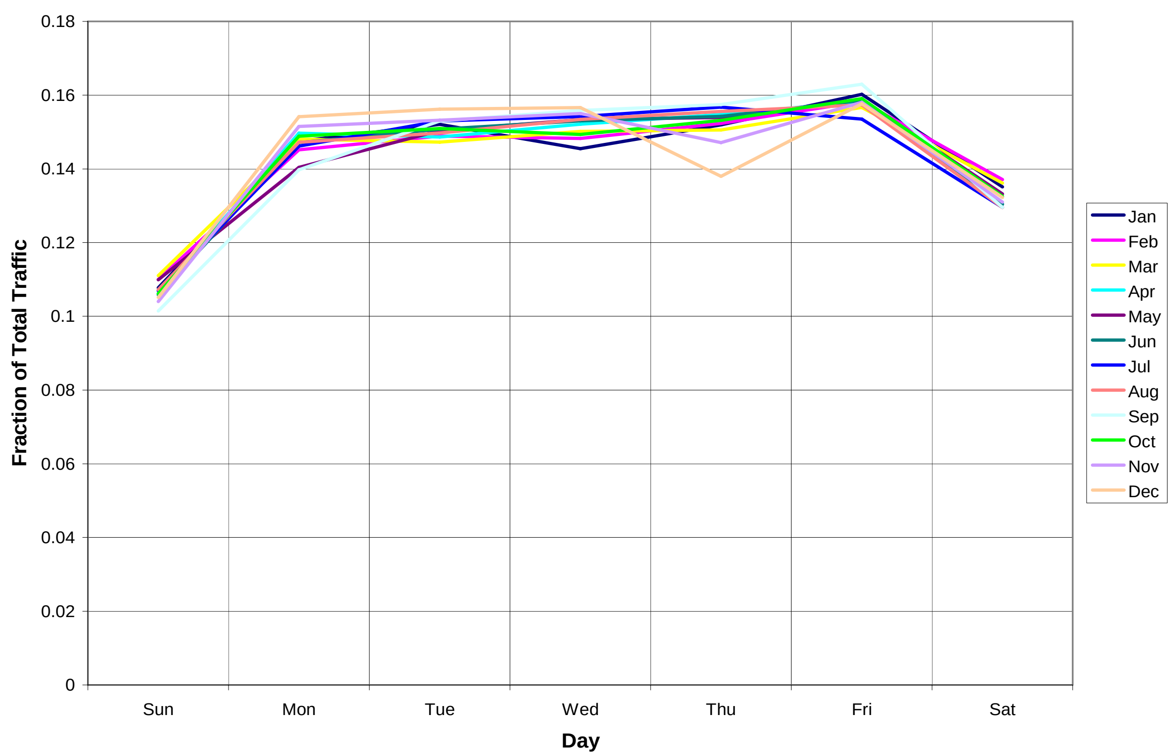


Figure 4-3. Example daily total volume profile – Clark County urban freeways and expressways.

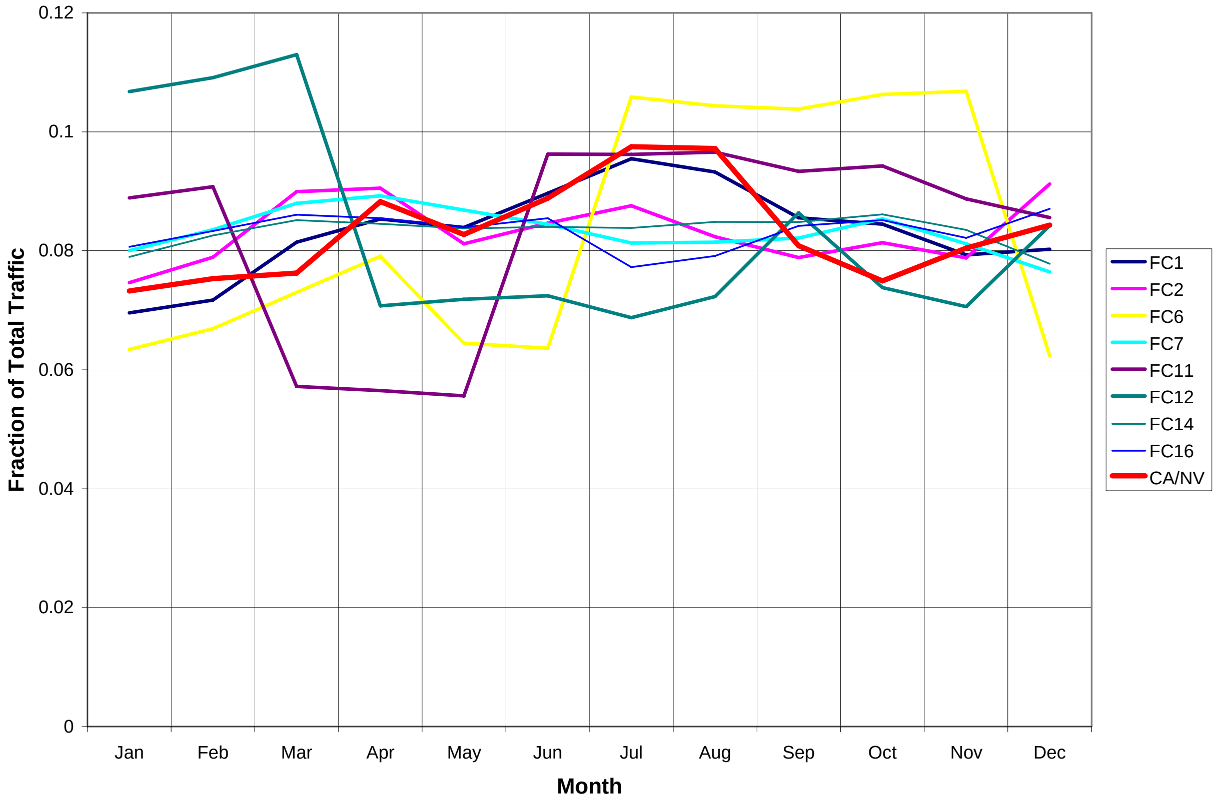


Figure 4-4. Monthly total volume profiles – Clark County urban freeways and expressways.

VEHICLE MIX PROFILES

After the traffic volumes have been disaggregated into hourly volumes, CONCEPT then disaggregates the total VMT into VMT by vehicle class (for the eight MOBILE5 vehicle classes). This is done using vehicle mix profiles by HPMS facility class, month, day of week, and hour of day. CONCEPT disaggregates the total VMT into the eight MOBILE5 classes using the relative fraction of each MOBILE5 class from the appropriate VMT mix profile.

The VMT mix profiles were developed from analysis of two databases: NDOT provided data from 46 vehicle classification monitoring sites with data in years 2002-2004, and data were also available from a special Las Vegas traffic monitoring study (Orth-Rogers Associates, 2003) – 68 vehicle classification monitors with data in years 1999 through 2002. Only the data from 2002 from the Las Vegas study were used.

There were not sufficient vehicle classification monitoring data to derive VMT mix profiles for all roadway types, months, and days of the week. For urban roadway types, VMT mix profiles were derived for two seasons: summer, defined as May through August, and winter, defined as September through April. For each season, VMT mix profiles were calculated by roadway type and day of week. For rural roadway types, there was sufficient data only to calculate profiles by roadway type and day of week, but not by month.

Figure 4-5 shows an example set of hourly VMT mix profiles, for urban freeways and expressways; this profile is used for all summer months (May through August). The plot shows that the light-duty vehicle fractions are highest during the daytime hours. Conversely, on weekdays the heavy-duty diesel fractions are lowest in the late afternoon and highest in the overnight hours. Figures 4-6 and 4-7 show example VMT mix profiles by day of week and month of year, respectively, again for urban freeways and expressways. The day of week and month of year VMT mix profiles are the same for all summer months, with a different set for all non-summer months; these plots show a higher fraction of light-duty VMT and a lower fraction of heavy-duty diesel VMT in the summer months.

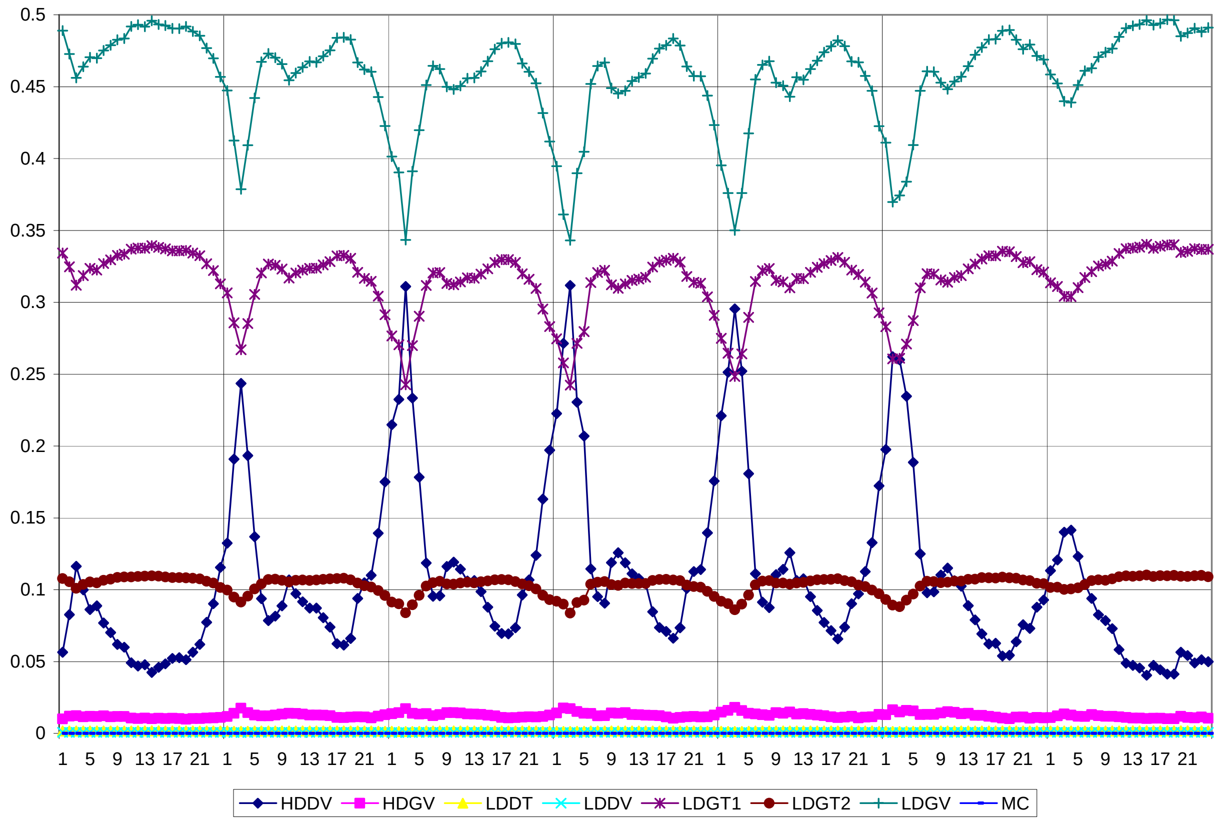


Figure 4-5. Example hourly VMT mix temporal profile – urban freeways and expressways, Sunday through Saturday for summer months.

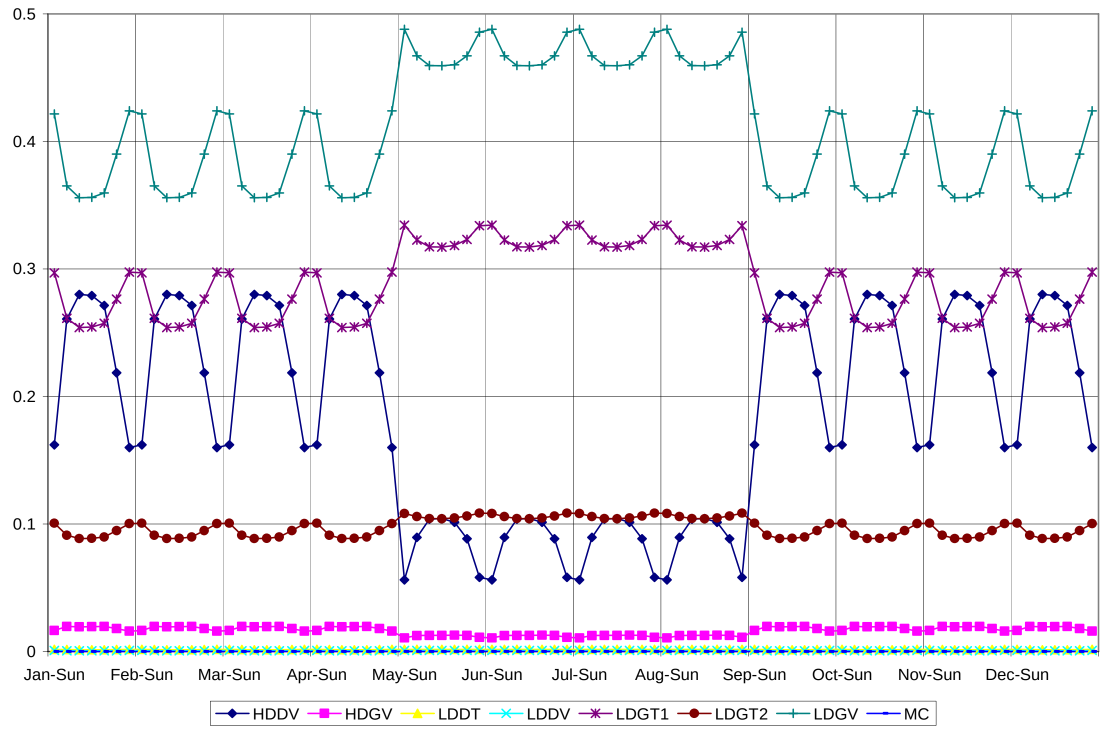


Figure 4-6. Example daily VMT mix temporal profile – urban freeways and expressways.

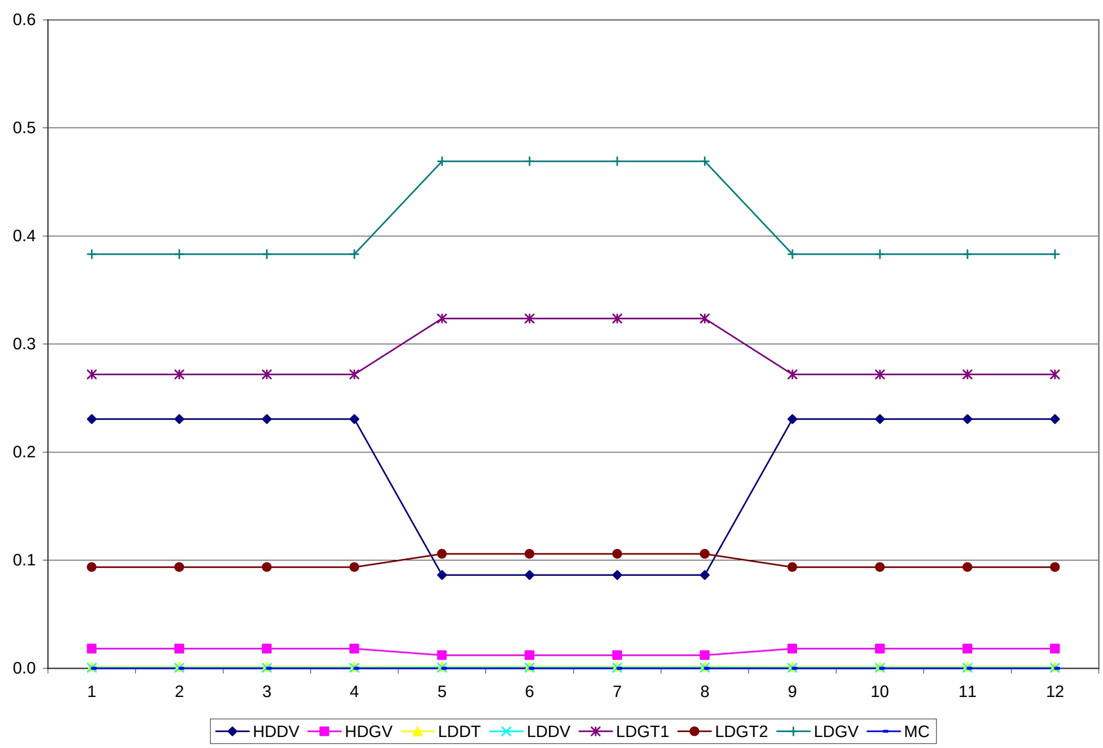


Figure 4-7. Example monthly VMT mix temporal profile – urban freeways and expressways.

CONCEPT MODELING FOR INTERSTATE 15

Interstate 15 is a route that is heavily used for traveling between Las Vegas and the Los Angeles area. Traffic is particularly heavy on I15 on Sunday evenings heading south to California, and special treatment was given to this roadway to take into account these varying traffic patterns.

All of I15 extending the Las Vegas Valley south to the California/Nevada border was modeled on a link basis using CONCEPT in an analogous manner as the RTC network was modeled. For the portion of I15 within the RTC modeling area from approximately Spring Mountain Road south, the detailed traffic counts and speeds from the RTC TransCAD data were modeled in the same way as the other links and speeds in the RTC network, except for the total volume temporal profile, as described below.

For the southern part of I15 extending from edge of the RTC modeling domain to the California/Nevada border, the RTC provided total volume per link for three links for historical and forecast years. There was one NDOT continuous observation monitoring site on this stretch of roadway, and that was located just before the California/Nevada border. Traffic counts per direction were determined for 24 hours for each of 7 days from the bi-directional count data from the I15 CA/NV monitoring site. The remaining temporal profiles needed for input to CONCEPT were derived from the NDOT I15 CA/NV monitoring site. These profiles were used for all of I15 from Spring Mountain Road to the CA/NV border. Figure 4-8 shows the daily total volume profiles by month for the I15 CA/NV monitoring site. In this figure one can clearly see the increase in traffic on Sundays. Although there is more traffic on I15 on Sundays, the heavy-duty diesel travel fraction is lowest on Sundays (see Figure 4-5). The result of this was that the NOx emissions were lower on Sundays than on weekdays, but with increased light-duty traffic the VOC emissions were higher on Sundays.

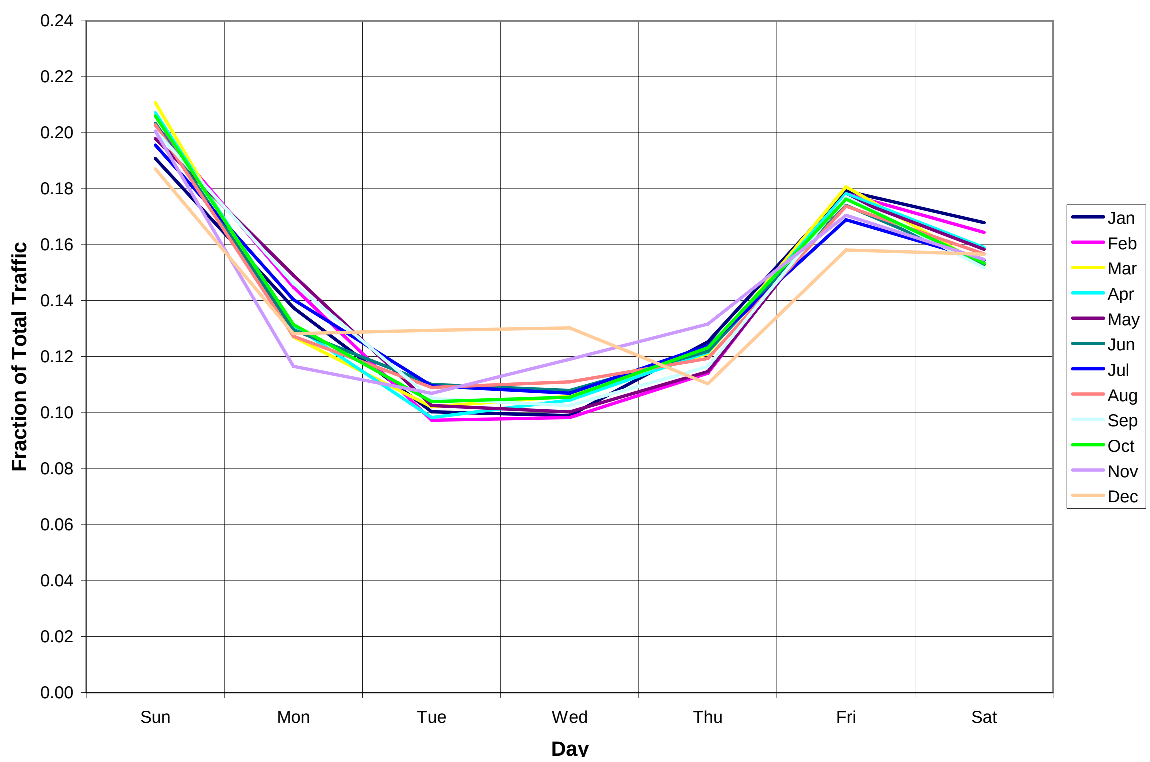


Figure 4-8. Daily total volume profile for southern portion of I15 (determined from monitoring site at the CA/NV border).

MOBILE6 inputs for this portion of I15 were the same as those used within the RTC network. While this stretch of roadway is in an area of Clark County not covered by a vehicle Inspection and Maintenance (I/M) program, MOBILE6 emission factors with I/M were used because it was assumed that the majority of the vehicles traveling on this stretch of Interstate were covered by either the Las Vegas I/M program or by a California I/M program.

As this I15 "network" is all Interstate road, no exhaust start or evaporative hot soak emissions were calculated.

USE OF RTC TRIPS DATA

As described in Section 3, the RTC provided trip starts (origins) and ends (destinations) for each of the seven time periods in the day for each of about 1200 traffic analysis zones (TAZs). The trips were allocated from the seven time periods to the hours of the day using the Las Vegas trip start distributions shown in Figure 4-1.

The original intention was to use these hourly trip starts and ends by TAZ in lieu of the MOBILE6 default assumptions on the number of trips per day. MOBILE6 uses trip starts and ends to estimate exhaust start and evaporative hot soak emissions, respectively. However, CONCEPT runs using the RTC trips as compared to MOBILE6 defaults showed that the emissions were significantly lower for both start and hot soak emissions with the RTC trips, because the trips per day in the RTC data were lower than MOBILE6 defaults.

The RTC trip starts and ends were therefore used for spatial allocation (by TAZ) of exhaust start and hot soak emissions, respectively. This was implemented in CONCEPT be setting up "pseudo-counties" for each TAZ. For each modeling year, CONCEPT was first run to estimate the trip-based emissions using the RTC trips data using the "pseudo county" approach, then run a second time without the TAZ data and using MOBILE6 default assumptions about number of trips per vehicle per day. Scaling factors for trip starts were derived from these two runs as start emissions from the MOBILE6 start exhaust emissions divided by start emissions from the run with the RTC trips by TAZ. These scaling factors were then applied to the RTC trips data and CONCEPT was rerun with the scaled up RTC trips by TAZ. Likewise, scaling factors for trip ends were derived by scaling from the hot soak emissions estimates for the CONCEPT runs with and without the RTC trips by TAZ. In this way the spatial allocation of trips by TAZ matched what was provided by the RTC, and the total trip-based emissions estimates were the same as would have been obtained using the default MOBILE6 trip assumptions.

5. CONCEPT MODELING TO ESTIMATE EMISSIONS IN CLARK COUNTY OUTSIDE THE RTC NETWORK AND I15

In the previous sections, we have described the data and methods used to estimate the link-based emissions in the Las Vegas Valley using the RTC transportation network, and also on the I15 links from the Valley to the California/Nevada border. In this section, we describe the data and methods that were used to estimate the on-road emissions in the remainder of Clark County (the rural portion of the county).

The steps taken to estimate the emissions in the rural portion of Clark County were as follows:

1. Estimate the rural vehicle miles traveled (VMT) by subtracting the RTC/I15 VMT from the Clark County total,
2. Estimate rural emission factors using EPA's MOBILE6 model,
3. Multiply the emission factors and VMT to estimate average daily emissions,
4. Use temporal profiles to allocate the average daily emissions to the hours in the modeling episode, and
5. Use spatial allocation surrogates to generate the gridded emissions needed for air quality modeling.

The rural emissions were thus estimated outside CONCEPT, whereas CONCEPT was used to estimate the emissions on the RTC and I15 links. CONCEPT was then used to temporally and spatially allocate the county total rural emissions using the area sources module. Details on the data used in these steps are provided below.

VMT and SPEEDS BY ROADWAY TYPE

Clark County total VMT (urban and rural) and speeds by roadway type for year 2002 are shown in Table 5-1. These were the VMT and speeds used for Clark County for 2002 in the emissions and air quality modeling performed for all counties in the western states for the Western Regional Air Partnership (WRAP) (Pollack et al., 2006).

Table 5-1. NDOT Clark County VMT and speed by roadway class

Function Class	AVMT	Speed
Rural Interstate	919,969,813	60
Rural Other Principal Arterial	358,059,127	45
Rural Minor Arterial	97,627,072	40
Rural Major Collector	265,040,631	35
Rural Minor Collector	44,407,630	30
Rural Local	441,727,584	30
Urban Interstate	1,826,089,525	50
Urban Other Freeways and Expressways	1,130,823,963	53
Urban Other Principal Arterial	1,527,861,362	33
Urban Minor Arterial	2,836,619,571	32
Urban Collector	1,234,892,911	33
Urban Local	1,425,788,145	20
Annual Total	12,108,907,334	
Daily Total	33,175,089	

The 2002 rural VMT by roadway type was derived from the rural Clark County VMT shown in Table 5-1 minus I15 south VMT. For future year rural VMT by roadway type, growth factors were developed and applied to the 2002 VMT. Growth factors were determined separately by roadway type. For rural interstates and rural principal arterials, the growth factors were calculated as the average growth in the forecast traffic volumes by major roadway segment as provided by the RTC. For rural arterials, collectors, and local streets, the growth factors were calculated from VMT forecasts for rural towns (Boulder City, Laughlin, Searchlight, Blue Diamond, Goodsprings, and Cal-Nev-Ari) as provided by the RTC.

Table 5-2. Rural Clark County VMT growth rates by roadway type.

Year	Interstates and Principal Arterials	Minor Arterials	Collectors	Locals
2003	1.018	1.016	1.016	1.016
2008	1.171	1.110	1.110	1.110
2013	1.329	1.205	1.205	1.205
2018	1.484	1.295	1.295	1.295

MOBILE6 INPUTS

The MOBILE6 inputs for the rural Clark County emission factors differed in a few inputs from the MOBILE6 inputs for the urban roadways (provided in Appendix A). There were three key differences in the MOBILE6 inputs. First, while the vehicles registered in the Las Vegas Valley are required to undergo an Inspection and Maintenance program (I/M), vehicles registered in the rural area are not. Second, the rural MOBILE6 inputs used all defaults for start emissions, whereas the Las Vegas Valley starts by hour distribution (Figure 4-1) was used for the RTC network and I15.

The third difference was in the VMT mix, i.e., the fraction of VMT by vehicle class. As described in Section 4, VMT mix profiles for modeling the RTC/I15 links by hour of day for each day of the week and month of the year were determined from analysis of NDOT vehicle classification monitoring data augmented with data from a Las Vegas monitoring program. For the rural portion of the county, the VMT mix was provided by the RTC based on the NDOT 2003 traffic report for rural areas in Nevada by roadway type (available at http://www.nevadadot.com/reports_pubs/traffic_report/2003/). The estimated fraction of VMT from heavy-duty diesel vehicles (HDDV) in the rural area is much higher than in the urban area: 32% on interstates, 17% for arterials and collectors, and 7% for locals.

For the RTC/I15 MOBILE6 inputs, DAQEM provided a registration distribution to be used in place of the MOBILE6 defaults (provided in Appendix A); this same registration distribution was used for the rural portion of the county. Also, the fuel sulfur levels were set to be the same in the rural area as in the Valley.

TOTAL VOLUME TEMPORAL PROFILES

Total volume (VMT) temporal profiles for Clark County rural roadways were derived from analysis of NDOT rural traffic counter data (excluding the southern portion of I15), in a similar manner as for urban roadways as provided in Section 4. There were fewer continuous traffic monitors, however, and so the temporal profiles for the rural area are not as detailed as for the urban area.

Figure 5-1 shows the hour-of-day temporal profiles by roadway type; these profiles were used for all weekday days. Except for the rural freeways, these profiles show some degree of morning and afternoon traffic, but the peaks are not as pronounced as the more typical urban hourly profiles, an example of which is in Figure 4-2. The hourly profiles derived for Saturday and Sunday are shown in Figure 5-2. These profiles show the typical weekend traffic pattern of a single less pronounced peak, as can be seen on the leftmost (Sunday) and rightmost (Saturday) sides of Figure 4-2. The day-of-week profiles by roadway type for the rural roads are shown in Figure 5-3. For all rural roadway types, traffic volumes were highest on Fridays.

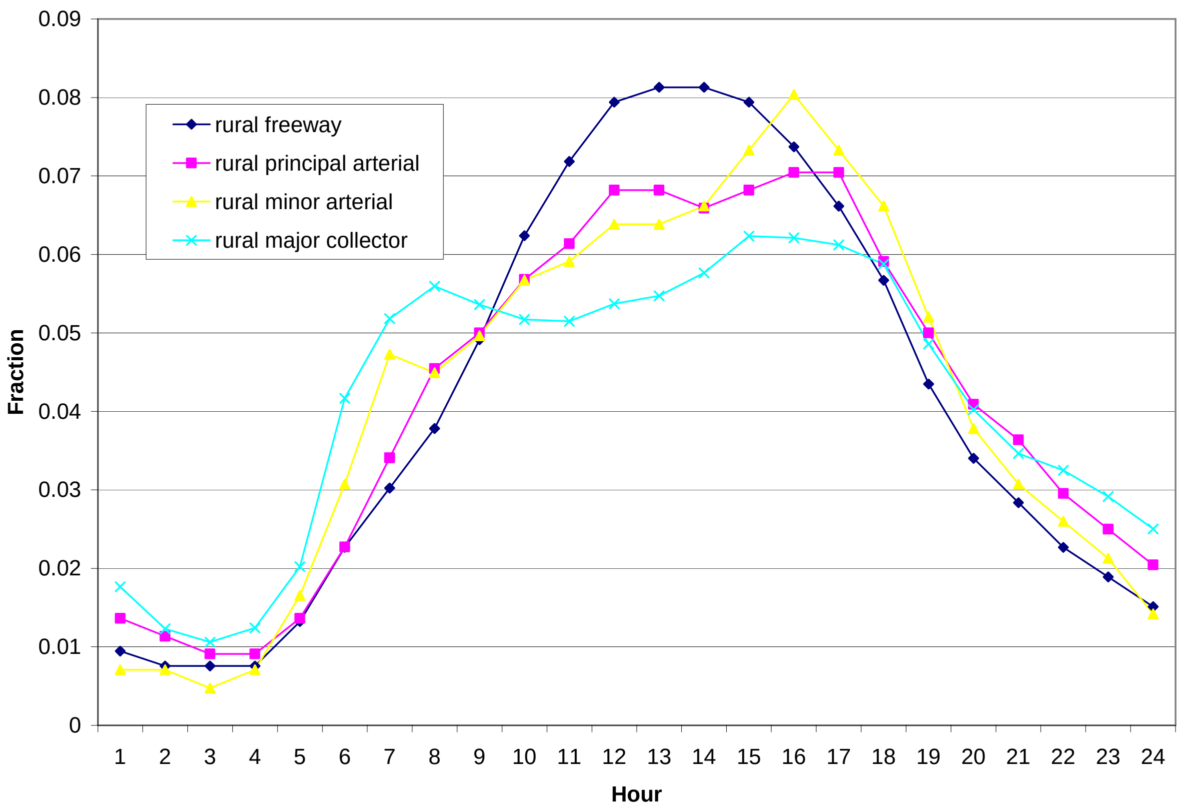


Figure 5-1. Rural Clark County weekday temporal profiles by roadway type.

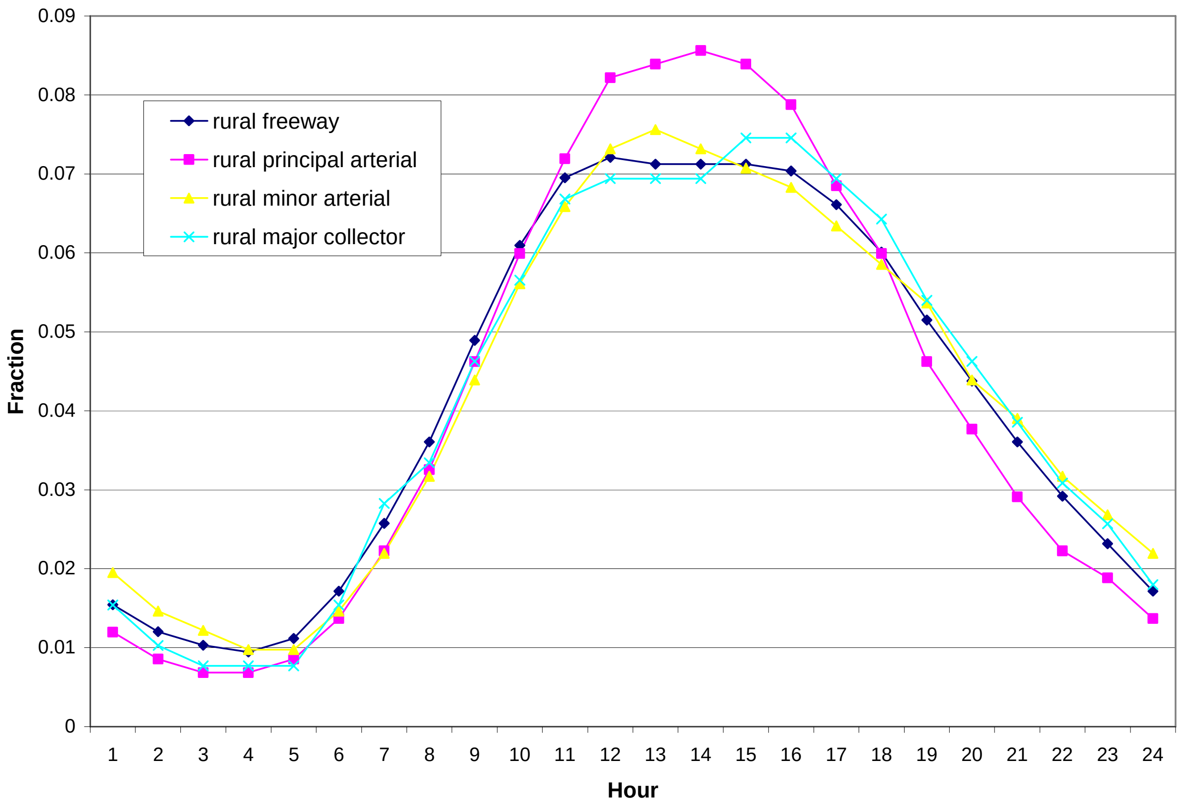


Figure 5-2. Rural Clark County weekend temporal profiles by roadway type.

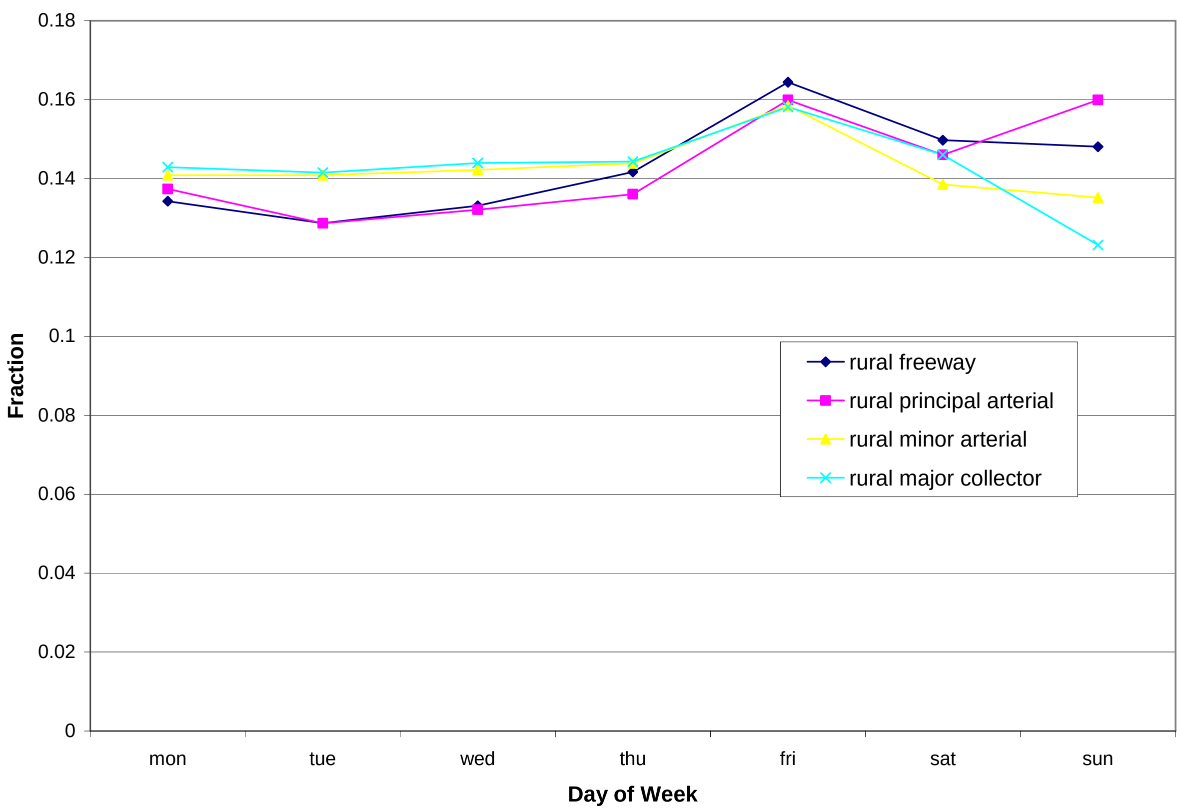


Figure 5-3. Rural Clark County day of week temporal profiles by roadway type.

SPATIAL SURROGATES FOR GENERATING GRIDDED EMISSIONS

The rural Clark County emissions (excluding the southern portion of I15) were generated using the procedures described above. The hourly emissions then were gridded for air quality modeling using roadway spatial surrogates for emission inventory modeling prepared by EPA based on the 2000 US Census TIGER/Line files. These data, including documentation describing attributes and various processing steps used, can be obtained via anonymous ftp from ftp.epa.gov/pub/EmisInventory/emiss_shp2003/us/.

Spatial allocation of regional or county-level emission estimates is accomplished through the use of gridding surrogates or spatial allocation factors (SAFs) for each emission source category or group of source categories. Spatial surrogates are typically based on the proportion of a known region-wide characteristic variable that exists within the modeling domain grid cells. Traditionally the development of spatial gridding surrogates has been performed by a variety of methods depending on the emission source category being considered, the required spatial resolution, the geographic extent of the domain, and the particular characteristics of the geospatial data available. Spatial surrogates must define the percentage of regional or county level emissions from a particular source category that is to be allocated to some spatial region, typically a modeling grid cell. For most area and off-road sources, these percentages are based on areas of a particular land use/land cover type while for on-road mobile source categories, the percentages are usually based on total length of a certain road type or a transportation network.

Gridding surrogates for the Clark County modeling were developed from spatial data describing transportation networks developed by EPA as noted above. The EPA roadway surrogates that were used, and how they were mapped to the HPMS roadway types, are listed in Table 5-3. The processing and development of gridding surrogates was performed using the Arc/INFO Geographic Information System (GIS). To develop gridding surrogates, or SAFs, the roadway surrogates database, the modeling domain grid, and the regional/county boundaries were first imported into the GIS as geospatial coverages. Through intersecting, or overlaying, these coverages, the appropriate linear percentages were calculated as follows. The spatial data were first intersected with the regional boundaries to generate a new coverage that contains arcs, with attribute associated with the spatial data and the regional boundaries. The total length of a particular roadway type, within each region or county can then be calculated. The resulting coverage was then overlaid with the modeling domain grid to associate the grid cell attributes (i and j cell indices) with the roadway lengths and regional boundary attributes. These procedures resulted in the generation of new arcs, each of which has all of these attributes as well as the corresponding lengths. The spatial allocation factors were then generated by forming ratios of the total length in each grid cell and county to the corresponding total length of each roadway type within each county. The resulting coverage was then exported as a text data file containing the fractional length for each spatial data type in each grid cell. The resulting data were then reformatted to provide the required gridded surrogate data file input to the emissions modeling system.

Table 5-3. Mapping of HPMS roadway types to EPA roadway surrogates.

EPA Roadway Surrogate	HPMS Roadway Types Mapped
Urban Primary roads	Urban Interstate Urban Other Freeways and Expressways Urban Other Principal Arterial
Urban secondary	Urban Minor Arterial Urban Collector Urban Local
Rural primary	Rural Interstate Rural Other Principal Arterial
Rural Secondary	Rural Minor Arterial Rural Major Collector Rural Minor Collector Rural Local

Because the RTC emissions were estimated as link-based emissions, the above procedure was slightly modified in order to avoid double-counting of emissions. Prior to processing the spatial data and developing the SAFs, the RTC region was first removed from the transportation network spatial coverages. The region outside of the RTC, but within Clark County, resulting from this step was then treated as a single complete county. The development of the spatial gridding surrogates then followed the procedures described above. Note that using this approach requires the emissions associated with the 'donut' portion of the modeling domain to be estimated based on activity data within the 'donut' portion of the domain only, as was done for the mobile source emissions developed for the project.

In addition to removing the RTC network region as part of the gridding surrogate development, the southern portion of I15 was also excluded from the 1.33km and 4km modeling domains. In this way, the rural county emissions were allocated only to grid cells outside the RTC and excluding I15 south.

Figure 5-4 shows the roadway spatial surrogates in the 1.33km modeling domain; the outer box in the figure is the 4km modeling domain. The I15 roadway surrogates from the Las Vegas Valley to the CA/NV border have been removed. Although it appears from the figure that there is a portion of I15 on the map, that is not I15 but rather S. Las Vegas Boulevard to Jean. Example plots of the resulting emissions gridded emissions are provided in Section 7.

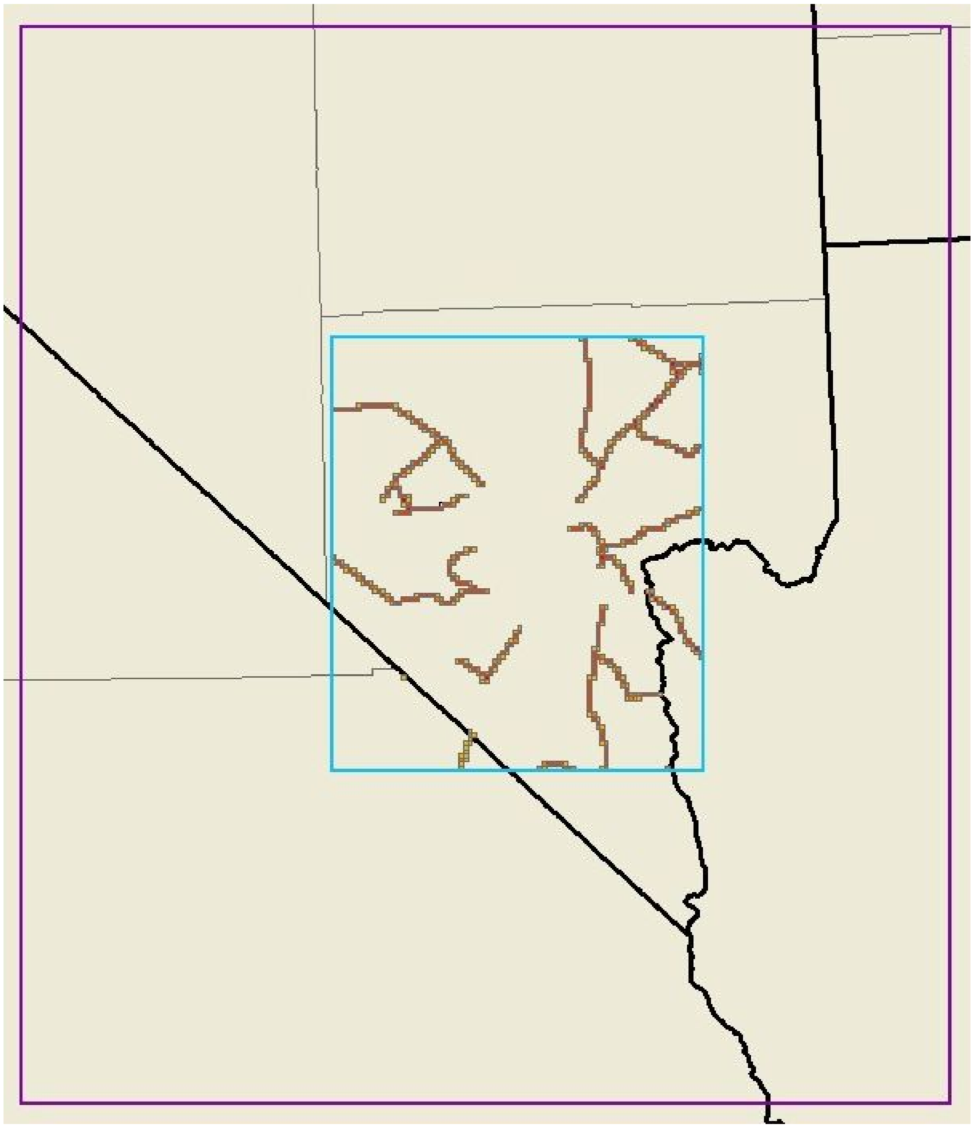


Figure 5-4. EPA roadway spatial allocation surrogates for the 1.33 km modeling domain.

6. ON-ROAD EMISSIONS OUTSIDE THE RTC NETWORK

This section describes the on-road emissions estimation and emissions processing for those portions of the 1.33km and 4km modeling domain shown in Figure 1-1 that are outside the RTC network (and excluding I15 southern portion). The 1.33 domain includes small parts of California and Arizona, and the 4km domain includes parts of California, Nevada, Arizona, and Utah. ENVIRON set up the processing of these portions of the 1.33km and 4km emissions for DAQEM modeling of the base and future years, using the county-level on-road inventories ENVIRON had prepared for the Western Regional Air Partnership (WRAP) (Pollack et al., 2006). This section briefly describes the development of the WRAP on-road emissions, and also discusses the temporal profiles and spatial allocation surrogates used to prepare CMAQ-ready files. The on-road emissions in the 1.33km and 4km domains outside the RTC network and I15 southern portion were processed in CONCEPT as area sources, in the same manner as for the rural Clark County emissions in the 1.33km modeling domain as described in the previous section.

WRAP ON-ROAD EMISSION INVENTORIES

Under contract to the WRAP, ENVIRON prepared comprehensive on-road and off-road mobile source county-level emission inventories for all counties in the Western U.S. (Pollack et al., 2006). As was done for the rural Clark County emissions described in Section 5, emissions were estimated as the product of vehicle miles traveled (VMT) and MOBILE6 emission factors, by roadway type, county, and season.

Fourteen states were included in the WRAP modeling: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. The emissions were estimated for an average day in each of the four seasons; seasons were defined as three-month periods, with summer defined as June through August. Emissions were estimated for the WRAP 2002 base year and for three future years – 2008, 2013, and 2018. For the DAQEM modeling, the WRAP emissions for 2002 were used for both 2002 and 2003.

The base and future VMT and MOBILE6 inputs for the WRAP modeling were developed in concert with air quality staff from each of the state air quality planning agencies as well as the major urban area transportation and air quality planning agencies. Agency personnel either provided all data files needed, or reviewed default files that ENVIRON established. The defaults for MOBILE6 fuel inputs were determined from analysis of available fuel survey data. The emissions were estimated for the eight MOBILE5 vehicle types for each of the 12 HPMS roadway types, by county, season, and year.

California has its own on-road emission factor model (EMFAC). At the time the WRAP emissions modeling was being performed, the California Air Resources Board (CARB) was in the process of updating the EMFAC model from version EMFAC2002 to EMFAC2007. CARB ran their internal working version of EMFAC2007 and provided the emissions to ENVIRON.

TOTAL VOLUME TEMPORAL PROFILES

Total volume temporal profiles were used to generate hourly emissions for each day in the modeling episode from the WRAP summer season average day emissions for each county. For the Imperial County, CA portion of the 1.33km and 4km modeling domains, where most of the VMT is assumed to occur on I15, the temporal profiles developed for the I15 south segments in the 1.33km modeling domain were used; the development of these profiles and was described in Section 4.

For the remainder of the 1.33km and 4km modeling domains, the temporal profiles developed for the WRAP modeling were used. The WRAP on-road temporal profiles were developed from an extremely large national database of detailed traffic counter data by vehicle class, roadway type, and state (Lindhjem, 2004). The databases used were the Federal Highway Administration (FHWA) Traffic Volume Trends (http://www.fhwa.dot.gov/policy/ohpi/travel/index.htm) for temporal activity of vehicles, and the FHWA Vehicle Travel Information System (VTRIS) (http://www.fhwa.dot.gov/ohim/ohimvtis.htm) that identifies individual vehicle classes to estimate temporal variation in the vehicle mix. Three sets of profiles were developed: hour of day profiles for weekdays, by vehicle class; hour of day profiles for weekends, by vehicle class; and day of week profiles by vehicle class.

The WRAP temporal profiles used are shown in Figures 6-1 to 6-3. The weekday hour of day profiles in Figure 6-1 show the important differences between light-duty and heavy-duty vehicle activity – light-duty vehicles have activity peaks in both the morning and afternoon rush hours, while heavy-duty vehicles have a more tempered and smooth single peak in the middle of the day. On weekends all vehicle classes have similar patterns (Figure 6-2), but light-duty vehicles have a larger fraction of their activity in the middle hours of the day. It is important to model the emissions of light- and heavy-duty vehicles properly, as morning NOx and VOC emissions contribute to afternoon ozone formation. Figure 6-3 shows the differences in vehicle activity by vehicle class across the days of the week, with heavy-duty vehicles having much less activity on weekends than on weekdays.

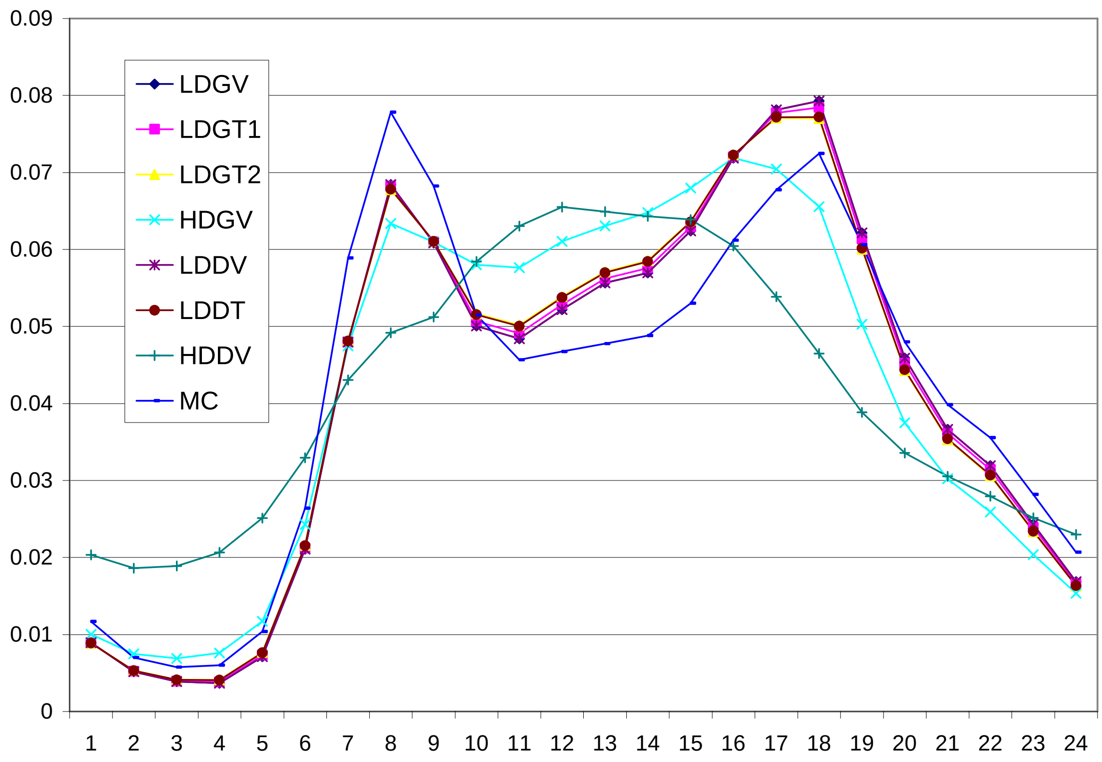


Figure 6-1. Weekday hour of day profiles by vehicle class.

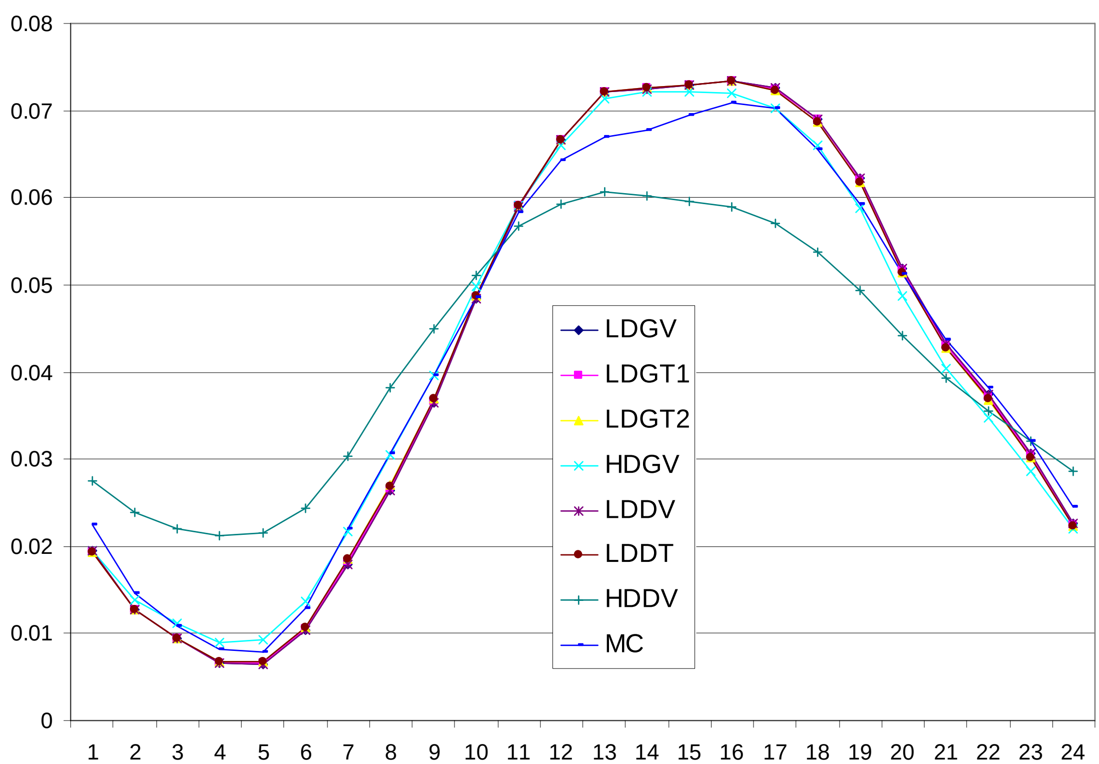


Figure 6-2. Weekend hour of day profiles by vehicle class.

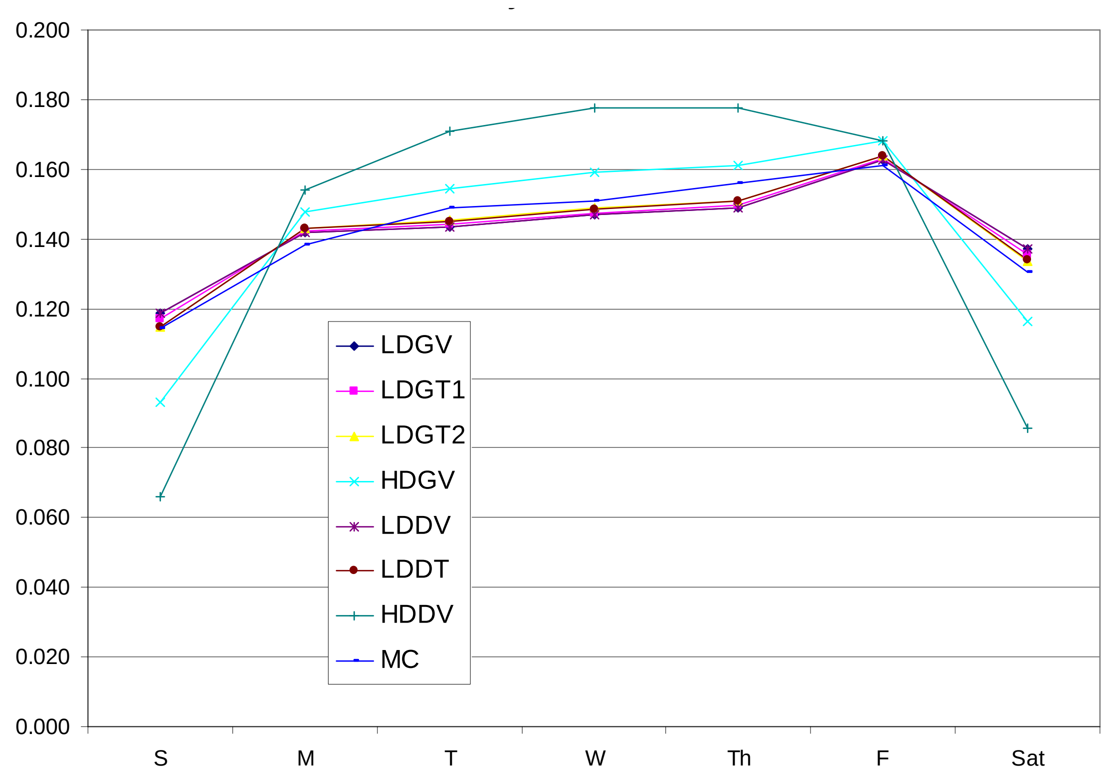


Figure 6-3. Day of week profiles by vehicle class.

SPATIAL SURROGATES FOR GENERATING GRIDDED EMISSIONS

Spatial surrogates were used to allocate the WRAP county-level emissions to the grid cells in the DAQEM 1.33 and 4km modeling domains outside the RTC network and I15 southern portion. The same EPA roadway surrogates developed from Census TIGER files as described in Section 5 were used, with the same mapping of HPMS roadway types to roadway surrogates as shown in Table 5-3. As was done for the link-level emissions modeling in the 1.33 km and 4km modeling domains, GIS was used to remove the roadway surrogates in the RTC network area, and also to exclude the southern portion of I15.

Figure 6-4 shows the roadway spatial surrogates in the 4 km modeling domain; the inner box in the figure is the 1.33 km modeling domain. Example plots of the resulting emissions gridded emissions are provided in Section 7.

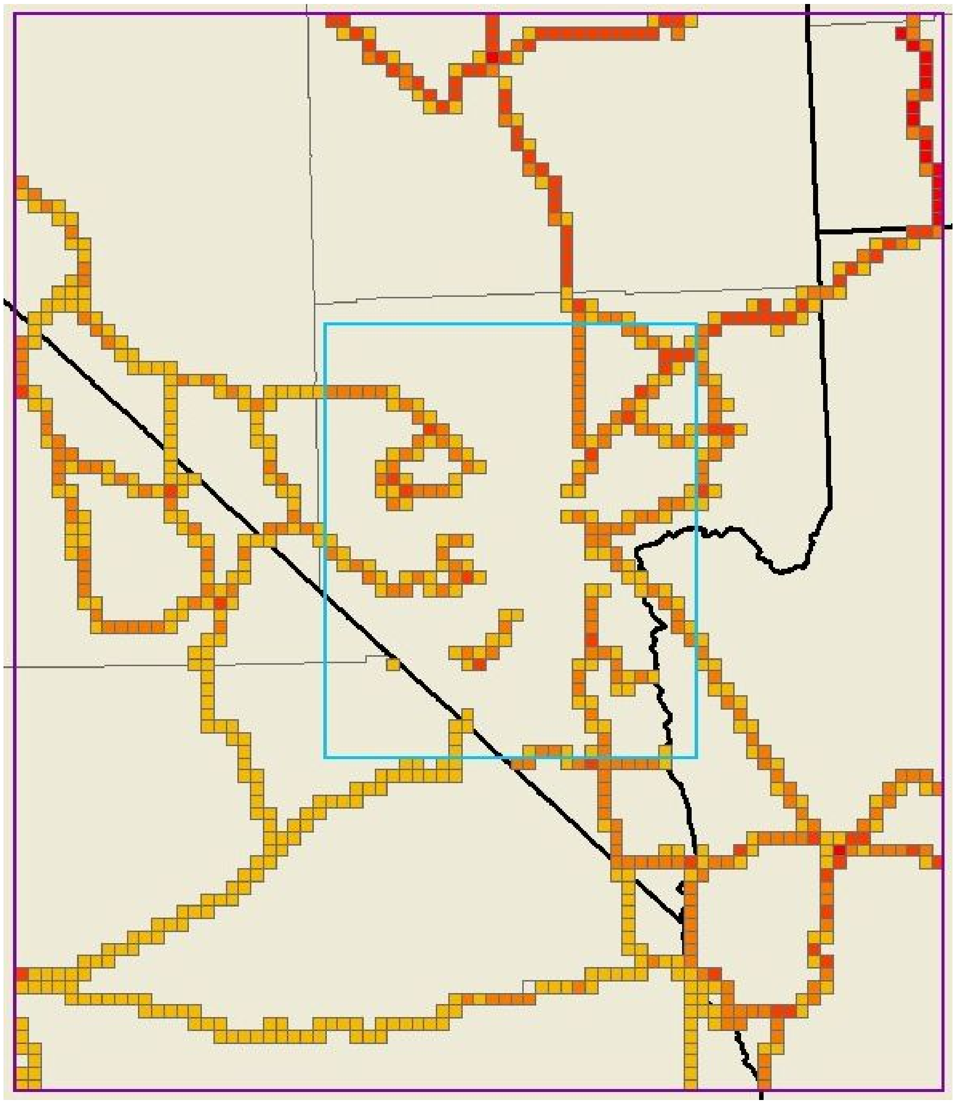


Figure 6-4. EPA roadway spatial allocation surrogates for the 4 km modeling domain.

7. EMISSION INVENTORY RESULTS

This section provides overall results as well as example graphical displays of the emission inventories that were generated using the procedures described in the preceding sections. For the Clark County SIP on-road emissions modeling, ENVIRON prepared all of the emissions inputs and performed the CONCEPT modeling for the link-based emissions and the county-level emissions for several days in each of the calendar years of interest. All of the modeling files were sent to DAQEM, and DAQEM performed the modeling for the full length of the episode of interest for all modeling years.

Figures 7-1 through 7-3 show a few of the example plots of the gridded emission inventories that were developed for Quality Assurance (QA) purposes. In all three of these figures, the gridded emissions are shown for the 1.33 km modeling domain, with a backmap of the links in the roadway system. The emissions are scaled from yellow (lower emissions per grid cell) to red (higher emissions per grid cell). Figure 7-1 shows an example plot of gridded TOG exhaust emissions in the Las Vegas Valley, i.e., developed using the RTC transportation network files. The exhaust emissions should appear in grid cells only where there are roadway links in the grid cell, and indeed that is the case in the plot. Figure 7-2 is a similar example, but for NOx exhaust emissions and with the I15 south links added. Again, one can see that there are emissions only in those grid cells where there are roadway links, and the higher emissions (red grid cells) occur on the largest roadways. Figure 7-3 shows NOx start emissions for the links in the 1.33 km domain, including I15 south. As discussed in Section 4, start emissions are spatially allocated to the RTC Traffic Analysis Zones (TAZs), and no start emissions were estimated for the southern I15 links. Figure 7-3 therefore shows start emissions in all cells in within the RTC transportation network area.

Figures 7-4 and 7-5 show gridded daily total VOC and NOx emissions, respectively, in the 1.33k modeling domain for Wednesday, July 9, 2003 (GMT). VOC emissions are highest in the central portion of the Valley. VOC emissions are predominantly from light-duty vehicles, and on a hot summer day there are many parked cars in the central Valley leading to increased evaporative emissions. On-road NOx emissions are heaviest on the interstates and freeways, with much of the NOx coming from heavy-duty diesel vehicles (HDDVs). On Interstate 15 on a weekday, HDDVs are by far the dominant source of NOX emissions.

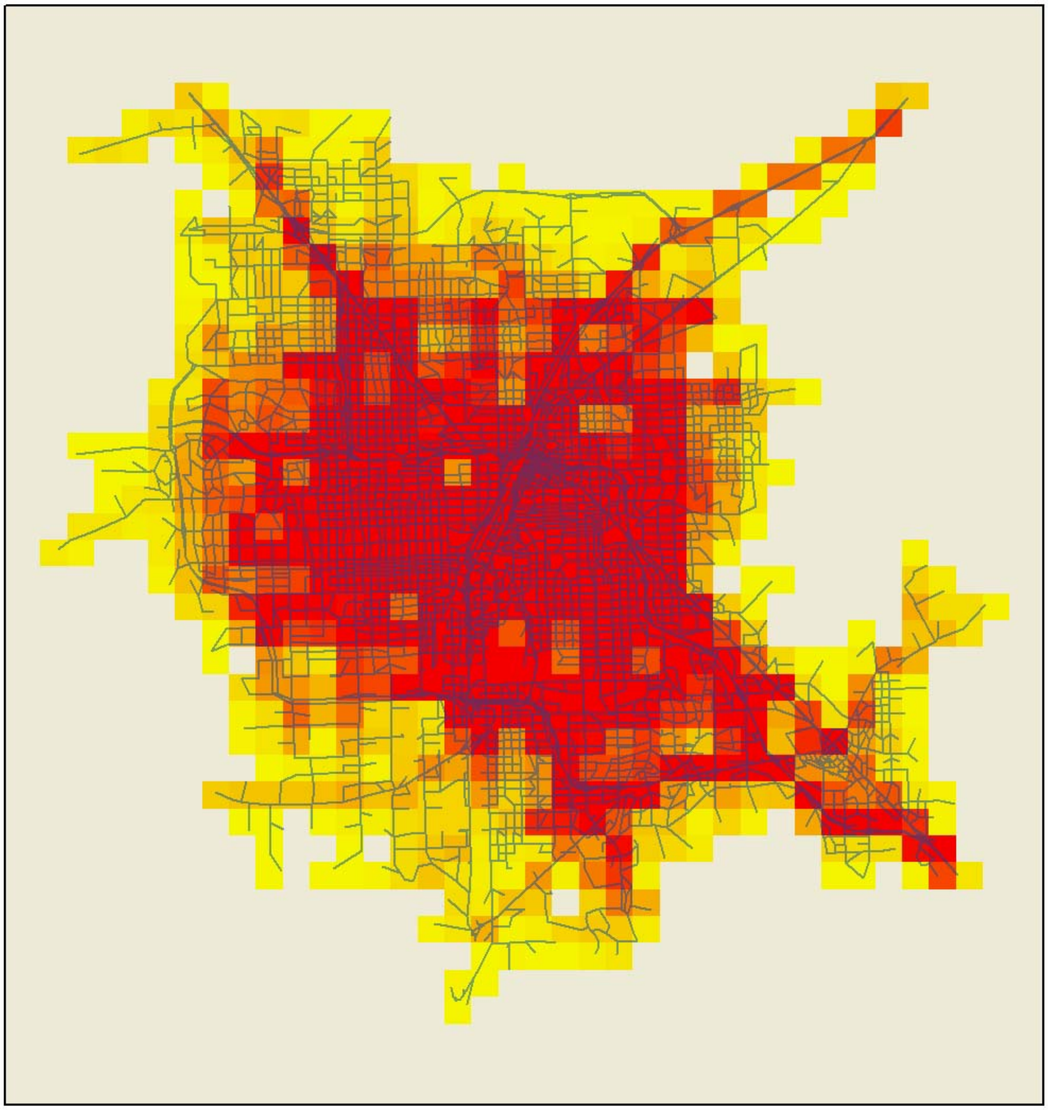


Figure 7-1. Example gridded emission display with roadway network: TOG exhaust emissions for the Las Vegas Valley roadway network.

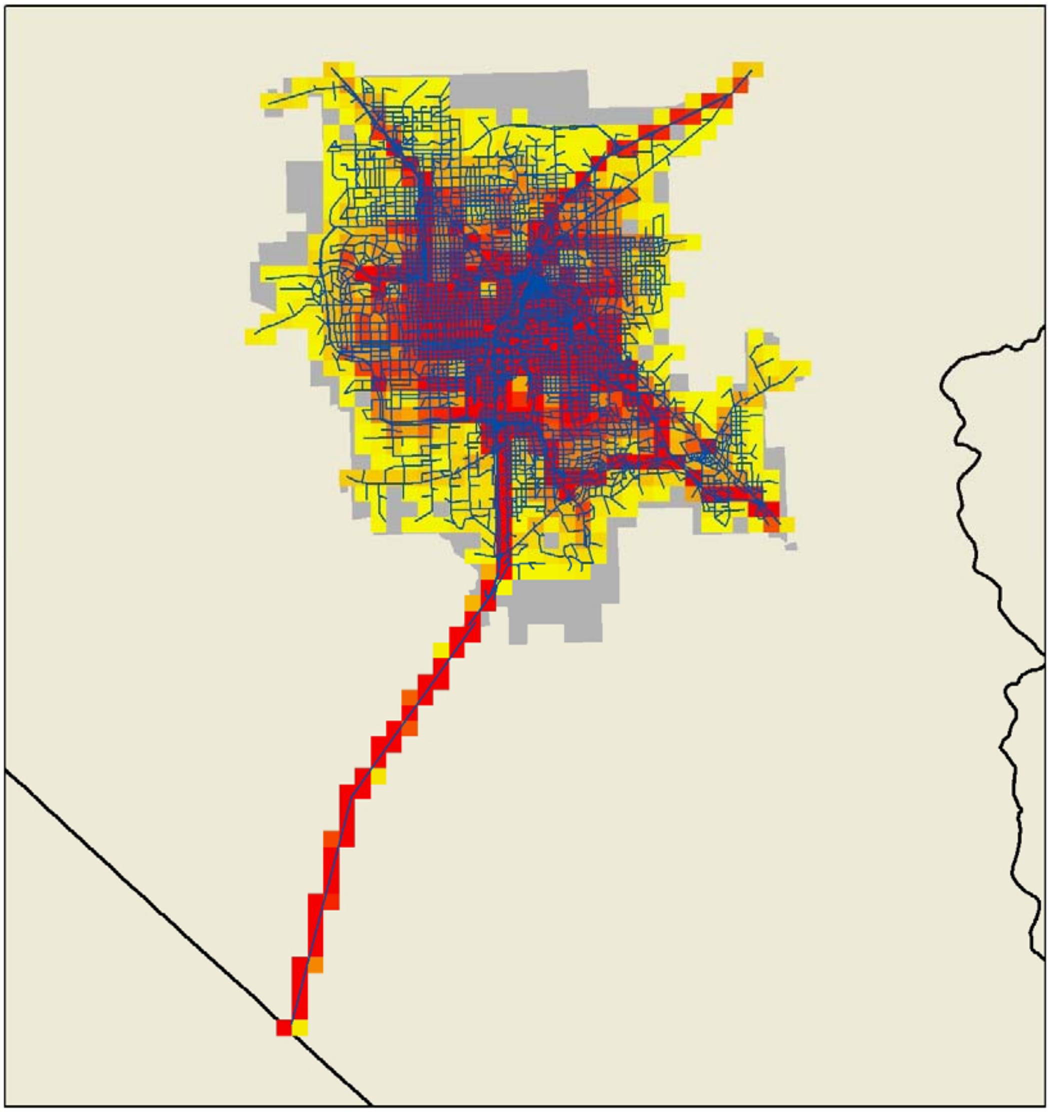


Figure 7-2. Example gridded emission display with roadway network: NOx exhaust emissions for the Las Vegas Valley roadway network and I15 southern portion.

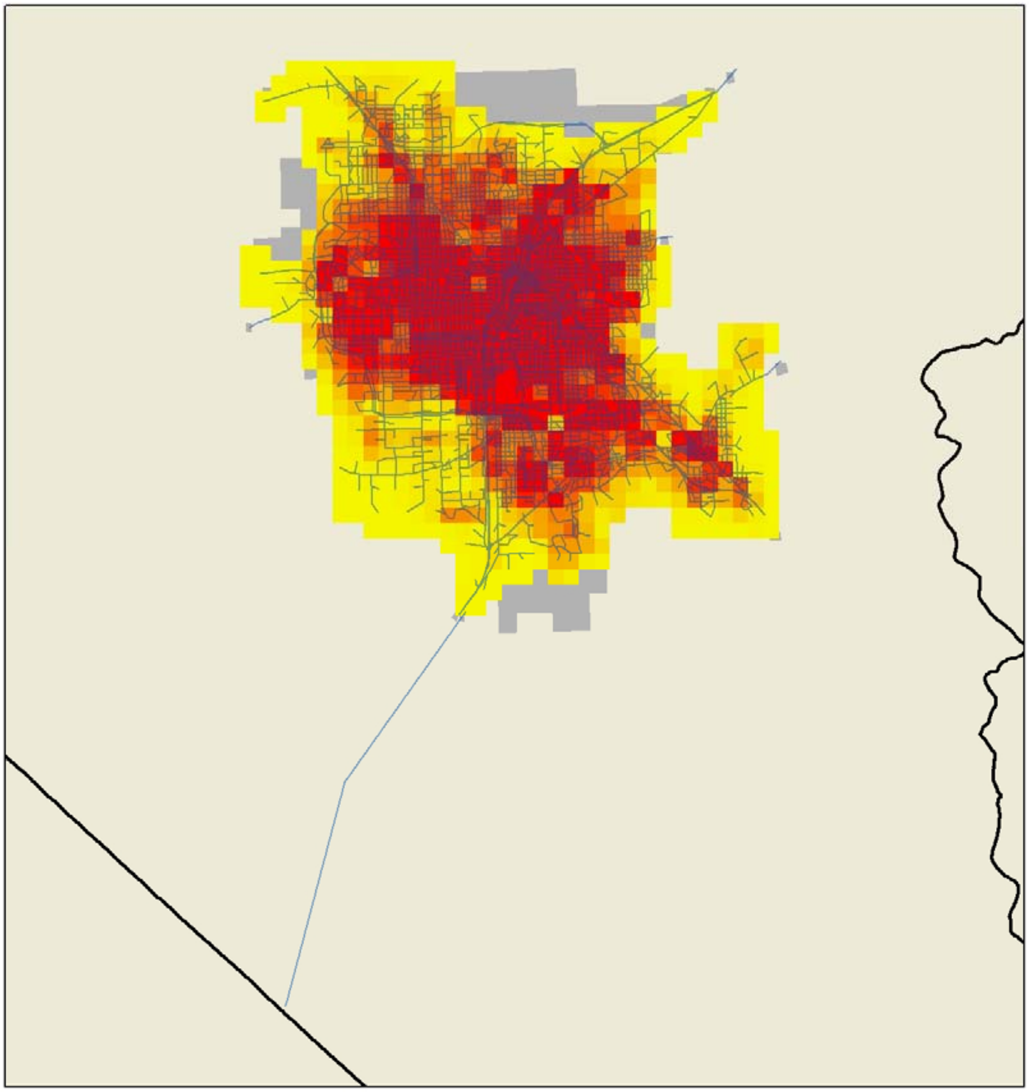


Figure 7-3. Example gridded emission display with roadway network: NOx start emissions for the Las Vegas Valley roadway network and I15 southern portion.

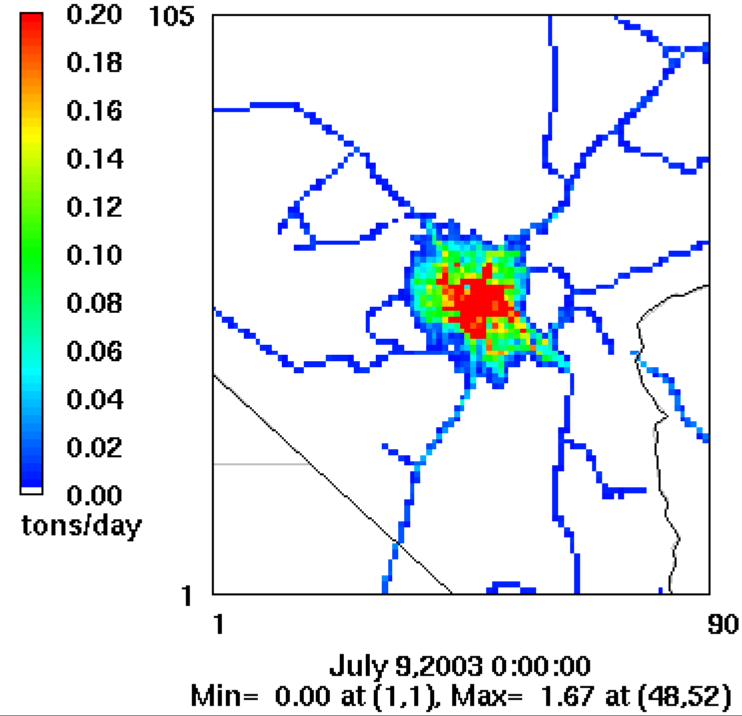


Figure 7-4. Daily total gridded on-road VOC emissions, 1.33k domain, 9 July 2003 (GMT)

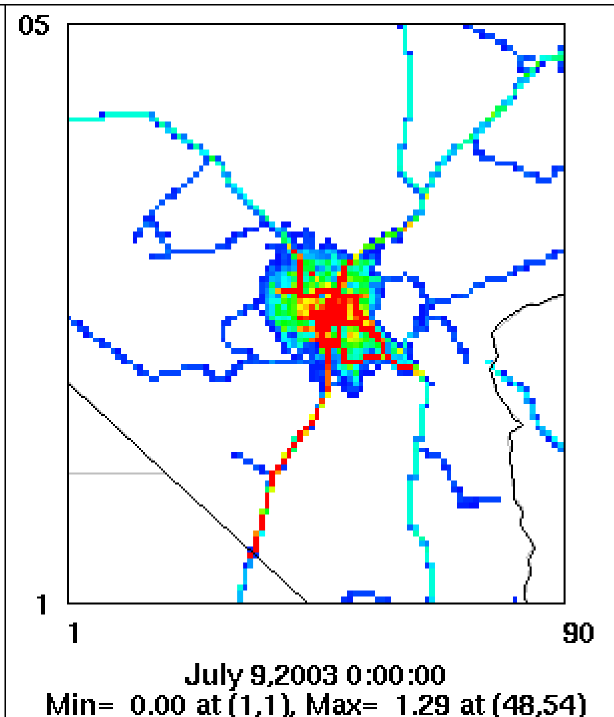


Figure 7-5. Daily total gridded on-road NOx emissions, 1.33k domain, 9 July 2003 (GMT)

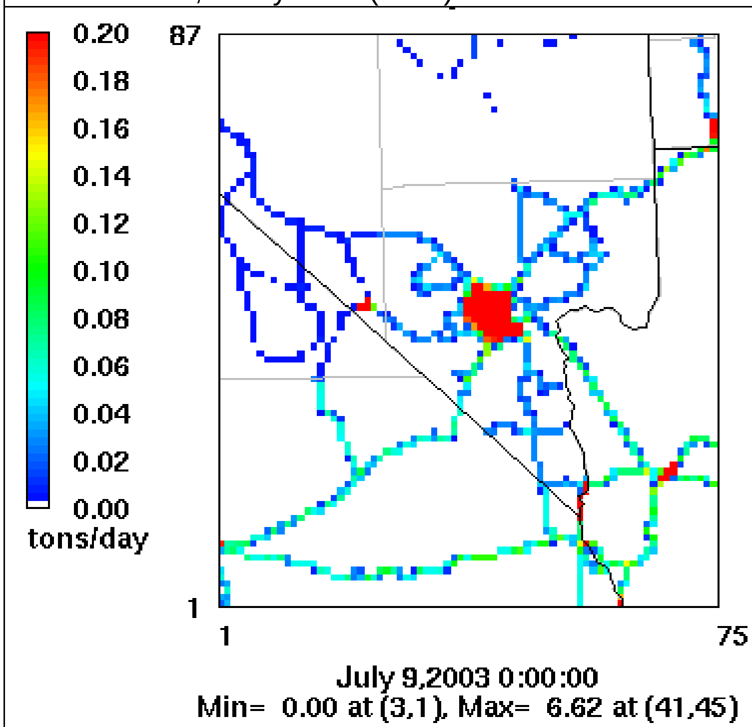


Figure 7-6. Daily total gridded on-road VOC emissions, 4k domain, 9 July 2003 (GMT)

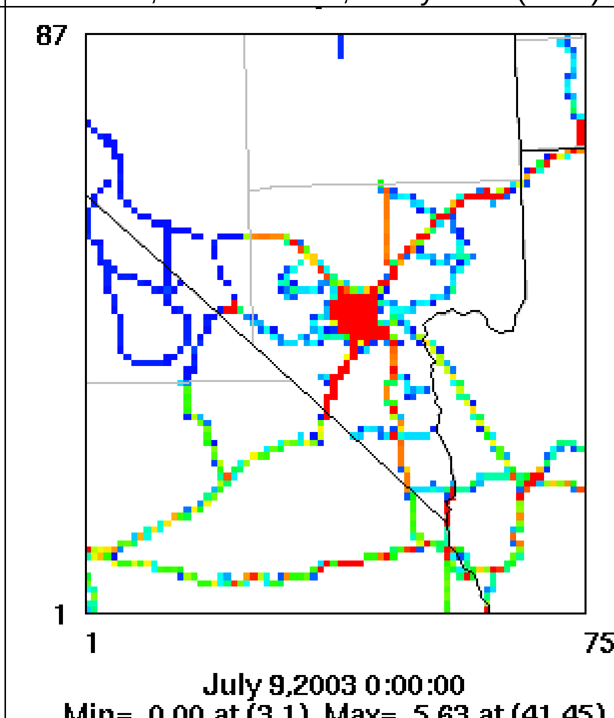


Figure 7-7. Daily total gridded on-road NOx emissions, 4k domain, 9 July 2003 (GMT)

Table 7-1 shows Clark County summer average day emissions for all years within the Las Vegas network (including the southern portion of I15) and within the county but outside the network. These emissions are the average of CONCEPT modeling results for one week in June and one week in July for each year. Despite a phenomenal increase in VMT over the 2002 to 2018 time period (7.4% per year as shown in Figure 3-4), emissions of all ozone precursors are decreasing over that time period. This is attributable to fleet turnover – as older vehicles are scrapped, they are replaced by newer vehicles meeting much tighter federal emissions standards. The most stringent light-duty standards are the so-called Tier 2 standards, which began with the 2004 model year; and the most stringent HDDV standards come into effect with the 2007 model year.

Table 7-1. Clark County Summer average day on-road emissions (TPD).

	TOG	CO	NOX
2002			
Las Vegas network	65.24	467.06	78.09
Outside network	7.89	85.06	25.03
Clark County total	73.13	552.12	103.12
2003			
Las Vegas network	64.85	456.87	77.42
Outside network	7.39	75.73	22.94
Clark County total	72.24	532.60	100.36
2008			
Las Vegas network	61.39	378.65	61.43
Outside network	5.32	48.66	14.66
Clark County total	66.71	427.31	76.08
2013			
Las Vegas network	48.46	333.25	39.52
Outside network	3.98	39.54	7.79
Clark County total	52.44	372.79	47.31
2018			
Las Vegas network	40.84	313.22	25.61
Outside network	3.36	36.67	4.63
Clark County total	44.20	349.89	30.24

REFERENCES

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APPENDIX A

MOBILE6 INPUT FILES FOR THE RTC TRANSCAD NETWORK

CONCEPT MOBILE6 Input File for 2002 and 2003

```
<mobile6>
    <repcounty country_id="US" state_fips="32" county_fips="003">
      <run>
               REG DIST           : lv_reg02.rdt
               NO REFUELING       :
               ANTI-TAMP PROG     :
               83 81 50 22222 22222222 2 11 90.0 22212112
               > Exhaust I/M program #1
               I/M PROGRAM        : 1 1983 2050 1 TRC 2500/IDLE
               I/M MODEL YEARS    : 1 1968 2050
               I/M VEHICLES       : 1 22222 22222222 2
               I/M COMPLIANCE     : 1 90.0
               I/M WAIVER RATES   : 1 0.1 0.1
               I/M STRINGENCY     : 1 22.0
               I/M EFFECTIVENESS  : 1.00 1.00 1.00
               I/M GRACE PERIOD   : 1 2
               I/M CREDIT FILE    : tech12.d
      </run>
        <scenario>
            FUEL RVP           : 9.0
            FUEL PROGRAM       : 4
                 60.0     60.0     60.0     60.0     60.0     60.0     33.0     33.0
                 30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0
                303.0    303.0    303.0    303.0    303.0    303.0     87.0     87.0
                 80.0     80.0     80.0     80.0     80.0     80.0     80.0     80.0
            DIESEL SULFUR      : 250.00
        </scenario>
    </repcounty>
    <repcounty country_id="US" state_fips="99" county_fips="000">
        <run>
               REG DIST           : lv_reg02.rdt
               NO REFUELING       :
               ANTI-TAMP PROG     :
               83 81 50 22222 22222222 2 11 90.0 22212112
               > Exhaust I/M program #1
               I/M PROGRAM        : 1 1983 2050 1 TRC 2500/IDLE
               I/M MODEL YEARS    : 1 1968 2050
               I/M VEHICLES       : 1 22222 22222222 2
               I/M COMPLIANCE     : 1 90.0
               I/M WAIVER RATES   : 1 0.1 0.1
               I/M STRINGENCY     : 1 22.0
               I/M EFFECTIVENESS  : 1.00 1.00 1.00
               I/M GRACE PERIOD   : 1 2
               I/M CREDIT FILE    : tech12.d
      </run>
      <scenario>
            FUEL RVP           : 9.0
            FUEL PROGRAM       : 4
                 60.0     60.0     60.0     60.0     60.0     60.0     33.0     33.0
                 30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0
                303.0    303.0    303.0    303.0    303.0    303.0     87.0     87.0
                 80.0     80.0     80.0     80.0     80.0     80.0     80.0     80.0
            DIESEL SULFUR      : 250.00
      </scenario>
    </repcounty>
</mobile6>
```

CONCEPT MOBILE6 Input File for 2008, 2013, and 2018

```
<mobile6>
    <repcounty country_id="US" state_fips="32" county_fips="003">
      <run>
                REG DIST           : lv_reg02.rdt
                NO REFUELING       :
                ANTI-TAMP PROG     :
                83 81 50 22222 22222222 2 11 90.0 22212112
                > Exhaust I/M program #1
                I/M PROGRAM        : 1 1983 2050 1 TRC 2500/IDLE
                I/M MODEL YEARS    : 1 1968 1995
                I/M VEHICLES       : 1 22222 22222222 2
                I/M COMPLIANCE     : 1 90.0
                I/M WAIVER RATES   : 1 0.1 0.1
                I/M STRINGENCY     : 1 22.0
                I/M EFFECTIVENESS  : 1.00 1.00 1.00
                I/M GRACE PERIOD   : 1 2
                I/M CREDIT FILE    : tech12.d
                *

                > Exhaust I/M  program #2
                I/M PROGRAM        : 2 1983 2050 1 TRC OBD I/M
                I/M MODEL YEARS    : 2 1996 2050
                I/M VEHICLES       : 2 22222 22222222 2
                I/M STRINGENCY     : 2 22
                I/M COMPLIANCE     : 2 90
                I/M WAIVER RATES   : 2 0.1 0.1
                * I/M EFFECTIVENESS  : 1.00 1.00 1.00
                I/M GRACE PERIOD   : 2 2


                > Evap I/M  program #3
                I/M PROGRAM        : 3 1983 2050 1 TRC EVAP OBD
                I/M MODEL YEARS    : 3 1996 2050
                I/M VEHICLES       : 3 22222 11111111 1
                I/M COMPLIANCE     : 3 90
                I/M WAIVER RATES   : 3 0.1 0.1
                I/M GRACE PERIOD   : 3 2
      </run>
        <scenario>
             FUEL RVP           : 9.0
             FUEL PROGRAM       : 4
                  60.0     60.0     60.0     60.0     60.0     60.0     33.0     33.0
                  30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0
                 303.0    303.0    303.0    303.0    303.0    303.0     87.0     87.0
                  80.0     80.0     80.0     80.0     80.0     80.0     80.0     80.0
             DIESEL SULFUR      : 15.00
        </scenario>
    </repcounty>
    <repcounty country_id="US" state_fips="99" county_fips="000">
        <run>
                REG DIST           : lv_reg02.rdt
                NO REFUELING       :
                ANTI-TAMP PROG     :
                83 81 50 22222 22222222 2 11 90.0 22212112
                > Exhaust I/M program #1
                I/M PROGRAM        : 1 1983 2050 1 TRC 2500/IDLE
                I/M MODEL YEARS    : 1 1968 1995
                I/M VEHICLES       : 1 22222 22222222 2
                I/M COMPLIANCE     : 1 90.0
                I/M WAIVER RATES   : 1 0.1 0.1
```

```
               I/M STRINGENCY     : 1 22.0
               I/M EFFECTIVENESS  : 1.00 1.00 1.00
               I/M GRACE PERIOD   : 1 2
               I/M CREDIT FILE    : tech12.d
               *

               > Exhaust I/M  program #2
               I/M PROGRAM        : 2 1983 2050 1 TRC OBD I/M
               I/M MODEL YEARS    : 2 1996 2050
               I/M VEHICLES       : 2 22222 22222222 2
               I/M STRINGENCY     : 2 22
               I/M COMPLIANCE     : 2 90
               I/M WAIVER RATES   : 2 0.1 0.1
               * I/M EFFECTIVENESS  : 1.00 1.00 1.00
               I/M GRACE PERIOD   : 2 2


               > Evap I/M  program #3
               I/M PROGRAM        : 3 1983 2050 1 TRC EVAP OBD
               I/M MODEL YEARS    : 3 1996 2050
               I/M VEHICLES       : 3 22222 11111111 1
               I/M COMPLIANCE     : 3 90
               I/M WAIVER RATES   : 3 0.1 0.1
               I/M GRACE PERIOD   : 3 2
      </run>
      <scenario>
            FUEL RVP           : 9.0
            FUEL PROGRAM       : 4
                 60.0     60.0     60.0     60.0     60.0     60.0     33.0     33.0
                 30.0     30.0     30.0     30.0     30.0     30.0     30.0     30.0
                303.0    303.0    303.0    303.0    303.0    303.0     87.0     87.0
                 80.0     80.0     80.0     80.0     80.0     80.0     80.0     80.0
            DIESEL SULFUR      : 15.00
      </scenario>
    </repcounty>
</mobile6>
```

Clark County registration distribution file (lv_reg02.rdt)

```
*Convert MOBILE5 Registration Fractions to MOBILE6-Based Registration Fractions
*
*Calendar Year:         2002.000User-Input
*
*MOBILE5b Reg Fractions
*          0.068   0.075   0.083   0.082   0.073   0.071   0.063   0.065   0.055   0.048
*          0.042   0.041   0.039   0.037   0.031   0.026   0.021   0.018   0.013   0.008
*          0.005   0.004   0.004   0.006   0.024
*          0.092   0.126   0.112   0.075   0.067   0.065   0.048   0.048   0.048   0.036
*          0.030   0.031   0.029   0.029   0.025   0.020   0.022   0.015   0.012   0.007
*          0.006   0.006   0.005   0.008   0.037
*          0.140   0.177   0.113   0.091   0.060   0.053   0.038   0.044   0.030   0.023
*          0.023   0.017   0.021   0.022   0.020   0.012   0.013   0.012   0.009   0.006
*          0.006   0.006   0.005   0.011   0.050
*          0.070   0.115   0.098   0.088   0.054   0.060   0.045   0.041   0.033   0.023
*          0.023   0.024   0.034   0.037   0.028   0.021   0.026   0.021   0.017   0.010
*          0.011   0.011   0.011   0.020   0.079
*          0.068   0.075   0.083   0.082   0.073   0.071   0.063   0.065   0.055   0.048
*          0.042   0.041   0.039   0.037   0.031   0.026   0.021   0.018   0.013   0.008
```

```
*          0.005   0.004   0.004   0.006   0.024
*          0.092   0.126   0.112   0.075   0.067   0.065   0.048   0.048   0.048   0.036
*          0.030   0.031   0.029   0.029   0.025   0.020   0.022   0.015   0.012   0.007
*          0.006   0.006   0.005   0.008   0.037
*          0.071   0.109   0.115   0.138   0.058   0.092   0.069   0.071   0.041   0.038
*          0.025   0.021   0.030   0.022   0.017   0.014   0.018   0.014   0.013   0.007
*          0.005   0.003   0.002   0.001   0.004
*          0.085   0.119   0.095   0.082   0.060   0.055   0.050   0.046   0.038   0.030
*          0.025   0.316   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
*          0.000   0.000   0.000   0.000   0.000
*
*
* MOBILE6 Vehicle Classes:
*  1  LDV    Light-Duty Vehicles (Passenger Cars)
*  2  LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2   Light Duty Trucks 2 (0-6,000 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6  HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
REG DIST
*                       RESULTING MOBILE6-BASED REGISTRATION FRACTIONS
*
*MOBILE6 REGISTRATION FRACTIONS BY VEHICLE CLASS AND AGE
* LDV           M5 LDGV
       1   0.068   0.075   0.083   0.082   0.073   0.071   0.063   0.065   0.055   0.048
           0.042   0.041   0.039   0.037   0.031   0.026   0.021   0.018   0.013   0.008
           0.005   0.004   0.004   0.006   0.024
* LDT1          M5 LDGT1
       2   0.092   0.126   0.112   0.075   0.067   0.065   0.048   0.048   0.048   0.036
           0.030   0.031   0.029   0.029   0.025   0.020   0.022   0.015   0.012   0.007
           0.006   0.006   0.005   0.008   0.037
* LDT2          M5 LDGT1
       3   0.092   0.126   0.112   0.075   0.067   0.065   0.048   0.048   0.048   0.036
           0.030   0.031   0.029   0.029   0.025   0.020   0.022   0.015   0.012   0.007
           0.006   0.006   0.005   0.008   0.037
* LDT3          M5 LDGT2
       4   0.140   0.177   0.113   0.091   0.060   0.053   0.038   0.044   0.030   0.023
           0.023   0.017   0.021   0.022   0.020   0.012   0.013   0.012   0.009   0.006
           0.006   0.006   0.005   0.011   0.050
* LDT4          M5 LDGT2
       5   0.140   0.177   0.113   0.091   0.060   0.053   0.038   0.044   0.030   0.023
           0.023   0.017   0.021   0.022   0.020   0.012   0.013   0.012   0.009   0.006
           0.006   0.006   0.005   0.011   0.050
* HDV2B         M5 HDVs (Combined HDGV and HDDV)
       6   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
           0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
           0.008   0.007   0.007   0.011   0.043
* HDV3          M5 HDVs (Combined HDGV and HDDV)
       7   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
           0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
           0.008   0.007   0.007   0.011   0.043
* HDV4          M5 HDVs (Combined HDGV and HDDV)
```

```
        8   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDV5          M5 HDVs (Combined HDGV and HDDV)
        9   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDV6          M5 HDVs (Combined HDGV and HDDV)
       10   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDV7          M5 HDVs (Combined HDGV and HDDV)
       11   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDV8a         M5 HDVs (Combined HDGV and HDDV)
       12   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDV8b         M5 HDVs (Combined HDGV and HDDV)
       13   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDBS          M5 HDVs (Combined HDGV and HDDV)
       14   0.070   0.112   0.106   0.112   0.056   0.075   0.056   0.055   0.037   0.030
            0.024   0.023   0.032   0.030   0.023   0.018   0.022   0.018   0.015   0.009
            0.008   0.007   0.007   0.011   0.043
* HDBT          M5 HDDVs
       15   0.071   0.109   0.115   0.138   0.058   0.092   0.069   0.071   0.041   0.038
            0.025   0.021   0.030   0.022   0.017   0.014   0.018   0.014   0.013   0.007
            0.005   0.003   0.002   0.001   0.004
* Motorcycles   M5 MC
       16   0.085   0.119   0.095   0.082   0.060   0.055   0.050   0.046   0.038   0.030
            0.025   0.316   0.000   0.000   0.000   0.000   0.000   0.000   0.000   0.000
            0.000   0.000   0.000   0.000   0.000
```

APPENDIX D

Clark County Airport Emission Inventory Report

Emissions Inventories for
Clark County Airport System Airports
For Inclusion in the
Ozone State Implementation Plan for
Clark County, Nevada

Prepared for:
Clark County Department of Aviation

Prepared by:
Ricondo & Associates, Inc.

FINAL
May 2006

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I. Introduction

The Clark County Department of Air Quality and Environmental Management (DAQEM) has requested inventories of emissions from stationary and mobile sources (on-road and nonroad) at the airports in the Clark County Airport System for inclusion in the State Implementation Plan (SIP) for ozone. This report documents air pollutant emissions inventories conducted for McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, Perkins Field Airport, the proposed South of Sloan Regional Heliport (Heliport), and the proposed airport in the Ivanpah Valley (Ivanpah Airport). Air pollutant emissions were inventoried for two historical years: 2002 and 2003. Air pollutant emissions inventories were also developed for three future years: 2008, 2013, and 2018. It is noted that the Heliport would not be operational until 2009; therefore, emissions inventories were not prepared for the Heliport for 2002, 2003, or 2008. The Ivanpah Airport would not be operational until 2017; therefore, emissions inventories were not prepared for that airport for 2002, 2003, 2008, or 2013.

Existing air quality analyses prepared for the Clark County Airport System were reviewed and data from those analyses were used to the extent possible in this analysis. Data in this report regarding the proposed Ivanpah Airport were based on information contained in *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport* **[I-1]** prepared by MWH Americas, Inc. in mid-2005. Planning for the proposed heliport and Ivanpah Airport are still on-going. The forecasts and emissions inventories presented in this report are preliminary and have been designed to be conservative for air quality planning purposes. Actual forecasts and emissions may differ in the future based on more detailed planning and analysis.

1.1 Regulatory Framework

The federal Clean Air Act of 1970 **[I-2]**, as amended, requires that states identify those areas where the National Ambient Air Quality Standards (NAAQS) are not met for specific air pollutants. The U.S. Environmental Protection Agency (EPA) has designated such areas as nonattainment areas. A state with a nonattainment area must prepare a SIP that details the programs and requirements to be used to meet the NAAQS by the deadlines specified in the *Clean Air Act Amendments of 1990* **[I-3].**

The U.S. EPA, pursuant to mandates of the federal Clean Air Act, as amended, has established primary and secondary NAAQS for seven air contaminants or criteria pollutants. These pollutants are: ozone (O_3), carbon monoxide (CO), particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). The primary standards were established at levels sufficient to protect public health with an adequate margin of safety. The secondary standards were established to protect public welfare from other adverse effects of air pollution.

Nonattainment areas that are brought into attainment for the NAAQS are reclassified as maintenance areas for the criteria pollutants. For these areas, a state must convert its regional plan to a maintenance plan. The U.S. EPA has defined two types of maintenance areas: a transport maintenance area, which means that the pollutants found in the region are transported in by trade winds from another region, and a non-transport maintenance area, which means that the pollutants are produced in the region.

1.2 Pollutants

The seven criteria pollutants mentioned above are described in the following paragraphs. Another group of substances, known as hazardous air pollutants (HAPs), are adverse to human and environmental health in small quantities and are regulated despite the absence of criteria documents. The identification, regulation, and monitoring of HAPs are relatively recent compared with such activities for the criteria pollutants. HAPs are generated by the combustion of natural gas for space and water heating, fuel storage and handling, and aircraft maintenance activities, which are sporadic sources of small amounts of benzene, formaldehyde, toluene, and xylene. Airports are minor sources of HAPs in Clark County.

1.2.1 Ozone (O_3)

Ozone, commonly referred to as smog, is formed in the troposphere (ground-level) rather than being directly emitted from pollutant sources. Ozone forms as a result of volatile organic compounds (VOCs) and oxides of nitrogen (NO_X) reacting in the presence of sunlight in the atmosphere. Ozone levels are highest in warm-weather months. VOCs and NO_X are termed "ozone precursors" and their emissions are regulated in order to control the creation of ozone.

Ozone damages lung tissue and reduces lung function. Scientific evidence indicates that ambient levels of ozone not only affect people with impaired respiratory systems (e.g., asthmatics), but also healthy children and adults. Ozone can cause health effects such as chest discomfort, coughing, nausea, respiratory tract and eye irritation, and decreased pulmonary (lung) function.

1.2.2 Carbon Monoxide (CO)

Carbon monoxide is a highly toxic, odorless, colorless gas formed by the incomplete combustion of fuels. The primary sources of CO in Clark County are automobiles and other ground-based vehicles. The health effects associated with exposure to CO are related to its affinity for hemoglobin in the blood. At high concentrations, CO reduces the amount of oxygen in the blood, causing heart difficulties in people with chronic diseases, reduced lung capacity, and impaired mental abilities.

1.2.3 Particulate Matter (PM_{10}) and Fine Particulate Matter ($PM_{2.5}$)

Particulate matter consists of solid and liquid particles of dust, soot, aerosols, and other matter small enough to remain suspended in the air for a long period of time. PM_{10} refers to particulate matter less than 10 microns in diameter and $PM_{2.5}$ refers to particulate matter less than 2.5 microns in diameter. These two classes of particulate matter represent that portion of particulate matter thought to represent the greatest hazard to public health. Particulate matter can accumulate in the respiratory system and is associated with a variety of negative health effects. Exposure to particulates can aggravate existing respiratory conditions, increase respiratory symptoms and disease, decrease long-term lung function, and possibly cause premature death. The segments of the population that are most sensitive to the negative effects of particulate matter in the air are the elderly, individuals with cardiopulmonary disease, and children. Aside from negative physical effects, particulate matter in the air causes a reduction of visibility and damage to paint and building materials.

A portion of the particulate matter in the air comes from natural sources, such as windblown dust and pollen. Manmade sources of particulate matter include combustion of materials, operation of automobiles, field burning, factories, vehicle movement or other manmade disturbances of unpaved areas, and photochemical reactions in the atmosphere. Secondary formation of particulate matter may occur in some cases where gases such as oxides of sulfur (SO_X) and NO_X interact with other compounds in the air to form particulate matter. Fugitive dust generated by construction activities is a major source of suspended particulate matter.

The secondary creators of particulate matter, SO_X and NO_X, are also major precursors of acidic deposition in the atmosphere, which contributes to acid rain. While SO_X is a major precursor of particulate matter formation, NO_X has other environmental effects. Specifically, NO_X has the potential to change the composition of some species of vegetation in wetland and terrestrial systems, create the acidification of freshwater bodies, impair aquatic visibility, create eutrophication (i.e., reduce dissolved oxygen) of estuarine and coastal waters, and increase the levels of toxins harmful to aquatic life.

1.2.4 Nitrogen Dioxide (NO_2)

Nitrogen dioxide is a poisonous, reddish-brown to dark brown gas with an irritating odor. NO_2 forms when nitric oxide reacts with atmospheric oxygen (O_2). Most sources of NO_2 are manmade sources; the primary source of NO_2 is high-temperature combustion. Significant sources of NO_2 at airports include boilers, aircraft operations, and vehicle movements. NO_2 emissions from these sources are highest during high-temperature combustion, such as during aircraft takeoff. NO_2 may produce adverse health effects, such as nose and throat irritations, coughing, choking, headaches, nausea, stomach or chest pains, and lung inflammations (e.g., bronchitis and pneumonia).

1.2.5 Sulfur Dioxide (SO_2)

Sulfur dioxide is formed when fuel that contains sulfur (typically, coal and oil) is burned, during the metal smelting process, and during other industrial processes. High concentrations of SO_2 are found in the vicinity of large industrial facilities. The physical effects of SO_2 include temporary breathing impairment, respiratory illness, and aggravation of existing cardiovascular disease. Children and the elderly are most susceptible to the negative effects of exposure to SO_2.

1.2.6 Lead (Pb)

Lead is a heavy metal solid that is bluish-white to silvery gray. Lead occurs in the atmosphere as lead oxide aerosol or lead dust. Historically, a significant source of airborne lead at airports has been ground access vehicles fueled by leaded gasoline. The amount of lead emissions from vehicles has decreased, however, as a result of the increased federal controls on leaded gasoline and the resultant increase in the use of unleaded gasoline in catalyst-equipped cars. Another source of lead at airports is the combustion of leaded aviation gasoline in piston-engine aircraft.

1.3 Standards

Federal and Clark County ambient air quality standards are summarized in **Table I-1**. The Clark County Board of County Commissioners has adopted ambient air quality standards for projects in Clark County that are identical to the federal standards.

1.4 Clark County Nonattainment Areas and SIP Status

Hydrographic Basin 212, which includes most of the urbanized portion of the Las Vegas Valley, is currently designated as a serious nonattainment area for both CO and PM_{10}. McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, and the proposed Heliport are located in Hydrographic Basin 212. Jean Airport and the proposed Ivanpah Airport are located in Hydrographic Basin 164A, which is outside of the CO and PM_{10} nonattainment areas. Perkins Field Airport is also located outside the boundaries of the defined CO and PM_{10} nonattainment areas.

On April 15, 2004, the U.S. EPA officially designated areas around the country that do not meet the 8-hour ozone standard as nonattainment. Hydrographic Basins 212 and 164A have been designated basic nonattainment areas for the 8-hour ozone NAAQS. All of the airports managed by the Department of Aviation, except Perkins Field Airport, are located in the 8-hour ozone nonattainment area.

The most current CO SIP for Clark County was submitted to the U.S. EPA in August 2000. The U.S. EPA approved the CO SIP on September 21, 2004. The most current PM_{10} SIP for Clark County was submitted to the U.S. EPA in June 2001. The U.S. EPA approved the PM_{10} SIP on June 9, 2004. The Clark County Department of Comprehensive Planning and the Clark County DAQEM are in the process of developing an attainment demonstration SIP for the 8-hour ozone standard. The 8-hour ozone SIP must be submitted to the U.S. EPA by June 2007.

Table I-1

Federal and Clark County Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard [1]	Secondary Standard
Ozone (O_3)	1-hour	0.12 ppm	Same as primary
	8-hour	0.08 ppm	Same as primary
Carbon Monoxide (CO)	8-hour	9.0 ppm	None
	1-hour	35.0 ppm	None
Nitrogen Dioxide (NO_2)	Annual	0.053 ppm	Same as primary
Sulfur Dioxide (SO_2)	Annual	0.03 ppm	--
	24-hour	0.14 ppm	--
	3-hour	--	0.50 ppm
Particulate Matter (PM_{10})	AGM	50 $\mu g/m^3$	Same as primary
	24-hour	150 $\mu g/m^3$	Same as primary
Fine Particulate Matter ($PM_{2.5}$)	24-hour	65 $\mu g/m^3$	Same as primary
	Annual	15 $\mu g/m^3$	Same as primary
Lead (Pb)	Quarter mean	1.5 $\mu g/m^3$	Same as primary

Notes:
AGM = Annual geometric mean
$\mu g/m^3$ = Micrograms per cubic meter
ppm = Parts per million
1/ The 1-hour ozone standard was revoked by the U.S. EPA on June 15, 2005, for all areas except 8-hour ozone nonattainment areas where the responsible governmental agency entered into an Early Action Compact (EAC). Clark County is not an EAC area.

Sources: Clark County Board of County Commissioners, *Air Quality Regulations,* Section 11, "Ambient Air Quality Standards", July 1, 2004 **[I-4]**; and U.S. Congress, *Clear Air Act of 1970* (Public Law 91-604 § 109 and 110).
Prepared by: Ricondo & Associates, Inc.

II. Modeling Tools

The airport emissions inventories were developed using the Emissions and Dispersion Modeling System (EDMS), version 4.3, which was developed by the Federal Aviation Administration (FAA) in cooperation with the United States Air Force (USAF). EDMS is the U.S. EPA's preferred guideline model for air quality analyses at airports. The model is primarily used to: (1) generate an inventory of emissions caused by sources on and around an airport or air base and (2) calculate pollutant concentrations in the surrounding environment. Data tables produced by the model include emission factors for civilian and military aircraft, civilian ground support equipment, and civilian motor vehicles.

The EDMS emissions inventory module incorporates U.S. EPA-approved methodologies for calculating emissions from aircraft, on- and off-road vehicles, and stationary sources. Pollutants currently included in the EDMS are CO, total hydrocarbons (HC), non-methane hydrocarbons (NMHC), VOCs, NO_X, SO_X, PM_{10}, and $PM_{2.5}$.

In 2001, the FAA re-engineered EDMS to incorporate new data and algorithms and released EDMS version 4.0.[1] EDMS version 4.3 includes advances in data inputs for aircraft performance and auxiliary power units (APUs), and new data for dispersion modeling. EDMS version 4.3 generates input files for AERMOD — a powerful next-generation dispersion model developed by the U.S. EPA. Earlier versions of the EDMS included algorithms from the U.S. EPA's PAL2 and CALINE 3 dispersion models. Pollutant concentrations estimated by the new versions of EDMS can be compared with all of the primary NAAQS except lead, and most of the secondary NAAQS.

Default civilian motor vehicle emissions factors in EDMS are based on model data in MOBILE6.2 for motor vehicle emissions factors for vehicle fleets between 1997 and 2020. The MOBILE6.2 emissions factors developed by the DAQEM were used in lieu of the default emissions factors incorporated in the EDMS database to model emissions from on-road motor vehicles. These emission factors more accurately represent conditions in the Las Vegas metropolitan area.

[1] The FAA has subsequently released EDMS versions 4.1, 4.11, 4.2, 4.21, 4.3, and 4.4. EDMS version 4.3 was the most current release of EDMS when this emissions analysis was conducted.

III. Airport-Related Emissions

The EDMS was used to estimate airport-related emissions from the following sources:

- Aircraft at two mixing heights — 3,000 feet and 6,535 feet above ground level (AGL) for all facilities[2]
- Auxiliary power units
- Ground support equipment (GSE)
- Ground access vehicles (associated with movements on roadways and in parking lots)
- Point sources, such as power plants, incinerators, fuel tanks, and surface coating facilities

The methodologies and assumptions used to model emissions at all seven Clark County Airport System facilities are described in the following sections. The airport emissions inventories, which are presented in Section IV, will be incorporated into the 8-hour ozone State Implementation Plan for Clark County.

3.1 Aircraft Emissions

Annual aircraft emissions are a function of the number of annual aircraft operations expressed as landing and takeoff (LTO) cycles, the aircraft fleet mix (types of aircraft used), and the length of time aircraft spend in each of the four modes of operation defined in EDMS: takeoff, climbout, approach, and idle. For emissions calculations, the EDMS treats the takeoff mode as the time from the start of the takeoff roll until an aircraft reaches 1,000 feet AGL. The climbout mode begins at 1,000 feet AGL and ends when the aircraft reaches the mixing height. The mixing height is set at 3,000 feet AGL in the EDMS by default but can be changed by the user. The approach mode begins at the mixing height and ends when the descending aircraft reaches the ground. The idle mode is the sum of the landing roll time, the taxiing time, and the time an aircraft spends in queue.

The EDMS database contains an expansive list of aircraft types (airframes) and engine types for use in air quality analyses. Aircraft emissions are estimated using emission factors associated with particular engine types and operating modes. Aircraft emission factors included in the EDMS version 4.3 database are based on information from engine manufacturers, information contained in the International Civil Aviation Organization (ICAO) Aircraft Engine Emissions Databank, and data provided in the EPA's *Procedures for Emission Inventory Preparation.* Volume IV: "Mobile Sources" **[III-1]**.

On May 24, 2005, the FAA issued guidance regarding the estimation of aircraft-related PM_{10} and $PM_{2.5}$ emissions. The FAA's first-order approximation (FOA) methodology is used to estimate particulate emissions from commercial jet-turbine aircraft engines. The FOA serves an interim purpose of determining particulate compliance issues now, while the science and accuracy of particulate measurement techniques mature. The nonvolatile portion of particulate matter is based on a correlation between a smoke number (SN) from the engine certification test and the fuel flow for a specific mode of operation, namely takeoff, climb out, taxi/idle, and approach. For some engines, a maximum SN is conservatively used because modal-specific SNs are not available. The volatile portion of particulate matter is derived from a limited number of field measurements and theoretical

[2] Aircraft emissions at Ivanpah Airport were modeled with a mixing height of 7,875 feet.

relationships. Due to the uncertainties associated with the currently available information, the volatile particulate matter estimates include an additional margin to be conservative.

The FOA method has been incorporated into the algorithms used in the EDMS version 4.3. The FOA method is only applicable to aircraft engines that have reported SNs and modal fuel flows. In cases where EDMS version 4.3 does not include aircraft particulate emission indices, particulate emission data from AP-42, Volume IV: Mobile Sources, were used to estimate aircraft-related PM_{10} and $PM_{2.5}$ emissions. The methodology used to calculate PM_{10} and $PM_{2.5}$ emissions for aircraft that did not have SNs is described in **Appendix A**. Other assumptions used to estimate aircraft-related emissions are discussed below.

3.1.1 Aircraft LTO Cycles

Table B-1 through **Table B-9** in **Appendix B** present annual LTO cycles and aircraft fleet mix data for McCarran International Airport, Henderson Executive Airport, North Las Vegas Airport, Jean Airport, Perkins Field Airport, the Heliport, and Ivanpah Airport. Information presented in the tables is based on data provided by the Clark County Department of Aviation and information provided in the supplemental sources noted below.

3.1.1.1 McCarran International Airport

For McCarran International Airport, 2002 and 2003 LTO cycles data were developed using FAA Airport Traffic Control Tower (ATCT) operations summaries. Future year LTO cycles data were based on information contained in the *Draft Forecast of Commercial Service Airport Activity in the Las Vegas Metropolitan Are* **[III-2]**.

3.1.1.2 North Las Vegas Airport

For North Las Vegas Airport, 2002 and 2003 LTO cycles data were developed using FAA ATCT operations summaries. LTO cycles data for future years were derived from the *Draft Southern Nevada Airport System Plan Update* **[III-3]**.

3.1.1.3 Henderson Executive Airport

For Henderson Executive Airport, 2002 and 2003 LTO cycles data were developed using FAA ATCT operations summaries. LTO cycles data for future years were derived from the *Draft Southern Nevada Airport System Plan Update.*

3.1.1.4 Jean Airport

For Jean Airport, 2002 and 2003 LTO cycles data were based on FAA Form 5010-1 records obtained from the Department of Aviation. LTO cycles data for future years were derived from the *Draft Southern Nevada Airport System Plan Update.*

3.1.1.5 Perkins Field Airport

For Perkins Field Airport, 2002 and 2003 LTO cycles data were developed using FAA ATCT operations summaries. LTO cycles for future years were derived from the *Draft Southern Nevada Airport System Plan Update.*

3.1.1.6 South of Sloan Regional Heliport Site

For the Heliport, information regarding helicopter LTO cycles were based on information contained in the *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport* **[III-4]**.

3.1.1.7 Ivanpah Airport

For Ivanpah Airport, LTO cycles data were based on information contained in the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*.

3.1.2 Fleet Mix

The following sections describe the source of the aircraft fleet mix data used in the airport emissions inventories. Tables B-1 through B-9 present EDMS aircraft and engine type data for each of the seven existing and proposed airports in the Clark County Airport System.

3.1.2.1 McCarran International Airport

Aircraft fleet mix data for McCarran International Airport for 2002 and 2003 were based on historical records maintained by the Department of Aviation. Aircraft engine types modeled for each aircraft type were identified by Ricondo & Associates, Inc. using information obtained from the airline on-time performance database produced by the U.S. Department of Transportation's Bureau of Transportation Statistics. The 2008, 2013, and 2018 aircraft fleet mix data were developed using information developed for the ongoing Federal Aviation Regulations (FAR) Part 150 Noise Compatibility Study Update.

3.1.2.2 North Las Vegas Airport

Aircraft fleet mix data for North Las Vegas Airport were based on information contained in the *2002 Airport Emissions Inventories – McCarran International, North Las Vegas, and Henderson Executive Airport*s **[III-5]**. Future aircraft fleet mix data were based on information contained in the *Final Environmental Assessment, Proposed Runway 12L-30R, North Las Vegas Airport* **[III-6]** and information obtained from air taxi operators at the airport.

3.1.2.3 Henderson Executive Airport

The 2002 aircraft fleet mix data for Henderson Executive Airport were based on information contained in the *2002 Airport Emissions Inventories – McCarran International, North Las Vegas, and Henderson Executive Airport*s. Aircraft fleet mix data for 2003, 2008, 2013, and 2018 were derived using information in the *2004 Aircraft Noise Report, Henderson Executive Airport* **[III-7]**.

3.1.2.4 Jean Airport

Aircraft fleet mix data for Jean Airport (all analysis years) were developed by Ricondo & Associates, Inc., based on conversations with Department of Aviation staff.

3.1.2.5 Perkins Field Airport

Aircraft fleet mix data for Perkins Field Airport (all analysis years) were developed by Ricondo & Associates, Inc., based on conversations with Department of Aviation staff.

3.1.2.6 South of Sloan Regional Heliport

Helicopter fleet mix data for the proposed Heliport were based on information contained in the *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport*.

3.1.2.7 Ivanpah Airport

Aircraft fleet mix data for the proposed Ivanpah Airport were based on information contained in the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*.

3.1.3 Taxi/Idle Time

As discussed previously, the EDMS recognizes four aircraft modes that constitute a complete LTO cycle: takeoff, climbout, approach, and taxi/idle. The aircraft time in mode is the time, in minutes, that a specific aircraft spends in any of these modes during an LTO cycle.

Of the four modes, the taxi/idle mode is the most variable, due to its airport-specific nature, and, accordingly, the EDMS user may modify the taxi/idle times. The EDMS incorporates default times for the taxi/idle mode of operation for each aircraft type contained in the model database. For commercial aircraft, the default taxi/idle time is 26 minutes. For general aviation (GA) aircraft, the default taxi/idle time is 16 minutes for piston-engine aircraft and 12 minutes for turbine-engine aircraft. These taxi/idle times include the time required to taxi to and from the runways as well as any delays encountered while the aircraft is on the ground.

To ensure that the airport emissions inventories appropriately accounted for and, in particular, did not underestimate aircraft taxi-in and taxi-out emissions, taxi times were investigated to determine if actual times were different from the default values in the EDMS database. Taxi times at each airport were investigated using the following methodologies:

- For McCarran International Airport, data from the Total Airspace and Airport Modeler (TAAM) developed by The Preston Group were used to determine average taxi-in, taxi-out, and delay times. For the 2002 and 2003 modeling scenarios, it was assumed that the taxi/idle mode spanned 18 minutes. It was assumed that taxi-out delay at McCarran International Airport would increase as the number of aircraft movements nears the capacity of the airfield. To account for this additional delay, taxi/idle times were increased to 21 minutes in the 2008 and 2013 modeling scenarios and to 25 minutes in the 2018 modeling scenario.
- For North Las Vegas Airport, Henderson Executive Airport, Jean Airport, and Perkins Field Airport, average taxi times for air tour operations and GA aircraft operations were estimated by calculating an average taxiing distance from the various gate areas to the runways, and calculating the time required at typical taxiing speeds and typical delays to traverse the distance. On the basis of the results of these analyses, the default EDMS taxi/idle times (16 minutes for piston-engine aircraft and 12 minutes for turbine-engine aircraft) were assumed for all aircraft operations at these airports.
- The EDMS default taxi/idle time of 7 minutes was used to model helicopters at the proposed Heliport to be consistent with information contained in the *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport*.
- Default taxi/idle times were used to model aircraft operations at the proposed Ivanpah Airport to be consistent with information contained in the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*.

3.2 Auxiliary Power Units

Many large commercial aircraft are equipped with auxiliary power units. An APU is basically a small turbine engine that generates electricity and compressed air to operate aircraft instruments, lights, and ventilation systems when the main aircraft engines are not operational, such as when aircraft are parked at the gate. APUs can also be used to provide power for starting the main aircraft engines. APUs burn jet fuel and, therefore, create exhaust emissions.

The methodology for calculating emissions from APUs is presented in Appendix E of *Air Quality Procedures for Civilian Airports and Air Force Bases* **[III-8].** This methodology has been incorporated into the EDMS. Emissions from APUs are tied to the number of LTO cycles performed by aircraft equipped with APUs, and the operating times of the APU per LTO cycle. Key assumptions regarding the use of APUs at each airport are summarized below.

- For McCarran International Airport, it was assumed that widebody and narrowbody aircraft are equipped with onboard APUs. The EDMS default operating time for APUs, 26 minutes, was used to develop the airport emissions inventories.
- APU operating assumptions for North Las Vegas Airport and Henderson Executive Airport were based on information contained in the *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports*. Additional information is provided in Section 3.3.
- APU operating assumptions for Jean Airport and Perkins Field Airport were developed to be consistent with assumptions for Henderson Executive Airport. Additional information is provided in Section 3.3.
- The emissions inventories prepared for the proposed Heliport assume no use of APUs.
- EDMS default APU assignments and operating times were used to develop the 2018 emissions inventory for Ivanpah Airport.

3.3 Ground Support Equipment

Ground support equipment includes a wide range of vehicles used to service aircraft. Examples of GSE include tugs that haul baggage carts and other equipment, fuel trucks, catering trucks and other service vehicles, and ground power units (GPUs) that provide electrical power to aircraft when they are parked and the engines are not running. The EDMS database includes default GSE assignments for each aircraft type expressed in terms of total operating times by specific type of GSE per LTO cycle.

For McCarran International Airport, default EDMS assumptions regarding GSE were compared with the results of a GSE inventory conducted by the Department of Aviation. On the basis of this comparison, EDMS default assignments of GSE were revised to reflect the proportion of fuel type used by the GSE, as determined in the 1996 inventory and summarized in **Table III-1**. GSE assignments and assumed GSE operating times by aircraft category used in the McCarran International Airport emissions analysis are summarized in **Table III-2.** Annual hours of GSE operation at McCarran International Airport for each analysis year are summarized in **Table III-3**.

For North Las Vegas and Henderson Executive airports, it was assumed that trucks are used to fuel all aircraft. As shown in **Table III-4** through **Table III-7**, it was assumed that GSE assignments at North Las Vegas and Henderson Executive airports vary by aircraft type. GSE equipment types and operating times for Jean Airport and Perkins Field Airport are summarized in **Tables III-8** and **III-9**, respectively. GSE equipment types and operating times assumed for the Heliport emissions inventories are summarized in **Table III-10**. The *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport* contains no data regarding the operation of GSE at Ivanpah Airport. The 2018 emissions inventory for Ivanpah Airport was developed using EDMS default GSE assignments and operating times.

Table III-1

1996 Ground Support Equipment Inventory, McCarran International Airport

GSE Type	Number of Units				
	Diesel	Gasoline	Electric	Propane	Total
Air Conditioner	8	1	—	—	9
Aircraft Stairs	3	3	—	—	6
Air Start	9	4	1	—	14
Belt Loader	9	79	—	—	88
Bob Tail	—	6	—	—	6
Cabin Service Truck	1	3	—	—	4
Cherry Picker	—	3	1	—	4
Container Loader	4	—	—	—	4
Deicer	2	4	—	—	6
Fork Lift	—	7	—	5	12
Fuel Tanker	2	4	—	—	6
Golf Cart	—	4	4	—	8
Ground Power Unit	8	2	—	—	10
High Lift	1	10	—	—	11
Hoist	—	1	—	—	1
Hydrant	—	28	—	—	28
Hydraulic Loader	6	2	—	—	8
Lavatory Truck	1	9	—	—	10
Lavatory Waste	--	1	—	—	1
Pushback	18	10	—	2	30
Scrubber	—	1	—	—	1
Support Vehicle	—	44	—	—	44
Tug	14	89	3	1	107
Water Cart	—	—	3	—	3
Total	86	315	12	8	421

Note:
GSE = Ground support equipment

Source: Ricondo & Associates, Inc., based on responses to the 1996 GSE survey for McCarran International Airport conducted by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-2

Ground Support Equipment Operating Times, McCarran International Airport

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle) 1/			
	Diesel	Gasoline	Electric	Total
Widebody Aircraft				
Aircraft Tractor (Wide)	8.0	0.0	0.0	8.0
Air Conditioner	0.0	0.0	30.0	30.0
Air Start	3.0	0.0	0.0	3.0
Bag Tug	11.1	70.7	3.2	85.0
Belt Loader	4.9	43.1	0.0	48.0
Cabin Service	3.7	11.3	0.0	15.0
Container Loader	92.0	0.0	0.0	92.0
Hydrant Fuel Truck	11.7	23.3	0.0	35.0
Lavatory Truck	2.0	18.0	0.0	20.0
Catering Truck	0.0	35.0	0.0	35.0
Water Service	0.0	12.0	0.0	12.0
Auxiliary Power Unit	0.0	26.0	0.0	26.0
Narrowbody Aircraft				
Aircraft Tractor (Narrow)	3.6	2.0	0.4	6.0
Air Conditioner	0.0	0.0	30.0	30.0
Air Start	3.0	0.0	0.0	3.0
Bag Tug	11.1	70.7	3.2	85.0
Belt Loader	4.9	43.1	0.0	48.0
Cabin Service	3.8	11.3	0.0	15.0
Hydrant Fuel Truck	11.7	23.3	0.0	35.0
Lavatory Truck	2.0	18.0	0.0	20.0
Catering Truck	0.0	35.0	0.0	35.0
Auxiliary Power Unit	0.0	26.0	0.0	26.0
Commuter / Business Jet				
Bag Tug	0.0	6.0	0.0	6.0
Fuel Truck (Midsize)	0.0	6.0	0.0	6.0
Ground Power Unit (28 V DC)	0.0	30.0	0.0	0.0
Aircraft Tractor (Narrow)	3.6	2.0	0.4	6.0
Belt Loader	4.9	43.1	0.0	48.0
Cabin Service	3.7	11.3	0.0	15.0
Lavatory Truck	2.0	18.0	0.0	20.0
Catering Truck	0.0	35.0	0.0	35.0
General Aviation				
Fuel Truck (Small)	0.0	6.0	0.0	6.0

Note:
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
1/ Some GSE vehicles at McCarran International Airport are powered by propane. Propane is not included in the EDMS database for GSE and hence could not be modeled.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-3

Ground Support Equipment Operating Times, McCarran International Airport

	Equipment Operating Time (hours per year)														
	2002			2003			2008			2013			2018		
GSE Type by Aircraft Category	Diesel	Gasoline	Electric	Diesel	Gasoline	Electric	Diesel	Gasoline	Electric	Diesel	Gasoline	Electric	Diesel	Gasoline	Electric
Widebody Aircraft															
Air Conditioner (Widebody)	0	0	3,010	0	0	2,432	0	0	3,271	0	0	4,720	0	0	6,515
Aircraft Tractor (Widebody)	803	0	0	648	0	0	872	0	0	1,259	0	0	1,737	0	0
Air Start Transporter (Widebody)	281	0	20	227	0	16	305	0	22	440	0	31	608	0	43
Air Start	301	0	0	243	0	0	327	0	0	472	0	0	652	0	0
Baggage Tractor (Widebody)	1,114	7,093	321	900	5,731	259	1,210	7,710	349	1,746	11,122	503	2,411	15,354	695
Belt Loader (Widebody)	492	4,324	0	397	3,494	0	534	4,700	0	771	6,780	0	1,064	9,360	0
Cabin Service Truck (Widebody)	371	1,134	0	300	916	0	403	1,232	0	582	1,778	0	804	2,454	0
Cargo Loader Wide, Lower Lobe	9,230	0	0	7,458	0	0	10,032	0	0	14,473	0	0	19,980	0	0
Hydrant Truck	1,174	2,338	0	948	1,889	0	1,276	2,541	0	1,841	3,665	0	2,541	5,060	0
Lavatory Truck (Widebody)	201	1,806	0	162	1,459	0	218	1,963	0	315	2,832	0	434	3,909	0
Catering Truck (Widebody)	0	3,511	0	0	2,837	0	0	3,817	0	0	5,506	0	0	7,601	0
Water Service	0	1,204	0	0	973	0	0	1,309	0	0	1,888	0	0	2,606	0
Total	13,966	21,410	3,351	11,284	17,298	2,707	15,179	23,271	3,642	21,898	33,571	5,254	30,231	46,345	7,254
Narrowbody Aircraft															
Air Conditioner (Narrowbody)	0	0	81,272	0	0	75,982	0	0	94,612	0	0	103,552	0	0	108,934
Aircraft Tractor (Narrowbody)	9,753	5,418	1,084	9,118	5,065	1,013	11,353	6,307	1,261	12,426	6,903	1,381	13,072	7,262	1,452
Air Start	8,127	0	0	7,598	0	0	9,461	0	0	10,355	0	0	10,893	0	0
Baggage Tractor (Narrowbody)	30,071	191,531	8,669	28,113	179,064	8,105	35,006	222,969	10,092	38,314	244,038	11,046	40,306	256,721	11,620
Belt Loader (Narrowbody)	13,274	116,761	0	12,410	109,161	0	15,453	135,926	0	16,914	148,770	0	17,793	156,502	0
Cabin Service Truck (Narrowbody)	10,024	30,612	0	9,371	28,620	0	11,669	35,637	0	12,771	39,005	0	13,435	41,032	0
Hydrant Truck (Narrowbody)	31,696	63,121	0	29,633	59,013	0	36,899	73,482	0	40,385	80,426	0	42,484	84,605	0
Lavatory Truck (Narrowbody)	5,418	48,763	0	5,065	45,589	0	6,307	56,767	0	6,903	62,131	0	7,262	65,360	0
Catering Truck (Narrowbody)	0	94,817	0	0	88,646	0	0	110,381	0	0	120,811	0	0	127,089	0
Water Service	0	32,509	0	0	30,393	0	0	37,845	0	0	41,421	0	0	43,574	0
Total	108,363	583,534	91,025	101,309	545,551	85,100	126,149	679,313	105,965	138,070	743,505	115,978	145,245	782,145	122,006
Commuter / Business Jet															
Baggage Tractor (Commuter)	0	2,428	0	0	3,466	0	0	3,348	0	0	3,927	0	0	4,884	0
Fuel Truck (Midsize 3,000-6,000 gallons)	0	2,428	0	0	3,466	0	0	3,348	0	0	3,927	0	0	4,884	0
Ground Power Unit (28 V DC)	0	12,138	0	0	17,332	0	0	16,742	0	0	19,634	0	0	24,418	0
Aircraft Tractor (Commuter)	1,457	809	162	2,080	1,155	231	2,009	1,116	223	2,356	1,309	262	2,930	1,628	326
Belt Loader (Commuter)	1,983	17,439	0	2,831	24,900	0	2,735	24,052	0	3,207	28,207	0	3,988	35,081	0
Cabin Service Truck (Commuter)	1,497	4,572	0	2,138	6,528	0	2,065	6,306	0	2,421	7,395	0	3,012	9,198	0
Lavatory Truck	809	7,283	0	1,155	10,399	0	1,116	10,045	0	1,309	11,780	0	1,628	14,651	0
Catering Truck (Commuter)	0	14,161	0	0	20,221	0	0	19,532	0	0	22,906	0	0	28,488	0
Total	5,745	61,257	162	8,204	87,469	231	7,924	84,491	223	9,293	99,084	262	11,558	123,232	326
General Aviation Aircraft															
Fuel Truck (Small < 3,000 gallons)	0	2,096	0	0	3,120	0	0	1,812	0	0	1,898	0	0	1,858	0
Helicopters															
Fuel Truck (Midsize 3,000-6,000 gallons)	5,766	0	0	4,606	0	0	8,728	0	0	3,217	0	0	3,683	0	0
Ground Power Unit (28 V DC)	23,065	0	0	18,425	0	0	34,913	0	0	12,867	0	0	14,733	0	0
Total	28,832	0	0	23,032	0	0	43,642	0	0	16,083	0	0	18,417	0	0

Notes:

GSE = Ground support equipment

LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

1/ Some GSE vehicles at McCarran International Airport are powered by propane. Propane is not included in the EDMS database for GSE and hence could not be modeled.

Columns may not add to totals shown because of rounding.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.

Prepared by: Ricondo & Associates, Inc.

Table III-4

Ground Support Equipment Operating Times, North Las Vegas Airport — 2002 and 2003

	Equipment Operating Time (minutes per LTO cycle)		
GSE Type by Aircraft Category	Diesel	Gasoline	Total
Cessna 150, Cherokee Six, Navajo			
Aircraft Tug (Narrow)	0.0	0.5	0.5
Fuel Truck	0.0	5.6	5.6
Cart	0.0	1.3	1.3
DHC-6, KingAir 200, Lear 35 / 36			
Aircraft Tug (Narrow)	0.0	0.5	0.5
Fuel Truck	12.8	0.0	12.8
Cart	0.0	1.3	1.3
APU GTCP 36 (80 HP)	0.0	1.5	1.5

Notes:
APU = Auxiliary power unit
HP = Horsepower
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-5

Ground Support Equipment Operating Times, North Las Vegas Airport — 2008, 2013, and 2018

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle)		
	Diesel	Gasoline	Total
BH-1900C			
Aircraft Tractor	5.0	0.0	5.0
Fuel Truck	20.0	0.0	20.0
Baggage Tractor	0.0	35.0	35.0
Ground Power Unit	0.0	40.0	40.0
Cessna 150, Cherokee Six			
Aircraft Tractor	0.5	0.0	0.5
Cart	1.3	0.0	1.3
Fuel Truck	5.6	0.0	5.6
DHC-6 / 300			
Aircraft Tractor	0.0	0.5	0.5
Cart	0.0	1.3	1.3
Fuel Truck	12.8	0.0	12.8
APU GTCP 36 (80 HP)	0.0	1.5	1.5
DO 328			
Aircraft Tractor	5.0	0.0	5.0
Baggage Tractor	0.0	35.0	35.0
Belt Loader	0.0	30.0	30.0
Cabin Service	10.0	0.0	10.0
Catering Truck	10.0	0.0	10.0
Fuel Truck	20.0	0.0	20.0
Lavatory Truck	15.0	0.0	15.0
Service Truck	15.0	0.0	15.0
APU GTCP 36 (80 HP)	0.0	1.5	1.5
KingAir 200, Learjet 35 / 36			
Aircraft Tractor	0.0	0.5	0.5
Cart	0.0	1.3	1.3
Fuel Truck	12.8	0.0	12.8
APU GTCP 36 (80 HP)	0.0	1.5	1.5
Navajo			
Aircraft Tractor	0.0	0.5	0.5
Cart	0.0	1.3	1.3
Fuel Truck	0.0	0.5	0.5

Notes:
APU = Auxiliary power unit
HP = Horsepower
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-6

Ground Support Equipment Operating Times, Henderson Executive Airport – 2002

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle) Diesel	Gasoline	Total
DHC-6, King Air 200, Learjet 35 / 36			
Aircraft Tractor	0.0	3.6	3.6
Fuel Truck	0.0	13.5	13.5
APU GTC 85	0.0	3.0	3.0
Cessna 150, Cherokee Six, Navajo			
Aircraft Tractor	0.0	3.6	3.6
Fuel Truck	0.0	6.0	6.0

Notes:
APU = Auxiliary power unit
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-7

Ground Support Equipment Operating Times, Henderson Executive Airport – 2003, 2008, 2013, and 2018

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle) Diesel	Gasoline	Total
Learjet 35 / 36, Cessna 172 Skyhawk, Cessna 441 Conquest			
Aircraft Tractor	0.0	3.6	3.6
Fuel Truck	0.0	13.5	13.5
APU GTC 85	0.0	3.0	3.0
Navajo, Comanche, Cherokee Six			
Aircraft Tractor	0.0	3.6	3.6
Fuel Truck	0.0	13.5	13.5
Bell 206			
Fuel Truck	0.0	6.0	6.0

Notes:
APU = Auxiliary power unit
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table III-8

Ground Support Equipment Operating Times, Jean Airport — 2002, 2003, 2008, 2013, and 2018

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle)		
	Diesel	Gasoline	Total
Cherokee Six, Navajo			
Aircraft Tractor	—	3.6	3.6
Fuel Truck	—	6.0	6.0

Notes:
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table III-9

Ground Support Equipment Operating Times, Perkins Field Airport — 2002, 2003, 2008, 2013, and 2018

GSE Type by Aircraft Category	Equipment Operating Time (minutes per LTO cycle)		
	Diesel	Gasoline	Total
Cherokee Six, Navajo			
Aircraft Tractor	—	3.6	3.6
Fuel Truck	—	6.0	6.0

Notes:
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table III-10

Ground Support Equipment Operating Times, South of Sloan Regional Heliport — 2013 and 2018

GSE Type by Helicopter Category	Equipment Operating Time (minutes per LTO cycle)		
	Diesel	Gasoline	Total
Bell 206			
Fuel Truck	10.0	—	10.0
Ground Power Unit	40.0	—	40.0

Notes:
GSE = Ground support equipment
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

3.4 Point Sources

Power generating and heating plants, incinerators, fuel storage tanks, and surface coating facilities are also sources of pollutant emissions at airports. For the Clark County Airport System emissions inventory, point sources owned and controlled by the Department of Aviation were modeled in the EDMS. Point sources not operated by the Department of Aviation but on airport property were not modeled in the EDMS.

Information regarding emissions from the central plant at McCarran International Airport was obtained from *Permitting Requirements for Existing Boilers, McCarran International Airport* **[III-9]** prepared by Dames & Moore. Information for all other point sources was obtained through consultation with Department of Aviation staff or from existing reports, including the *Final Supplemental Environmental Assessment for the Construction of Terminal 3 at McCarran International Airport* **[III-10]** and the *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports*. Point source data for Ivanpah Airport was based on information contained in the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*.

Table III-11 presents a summary of point sources at McCarran International Airport. **Table III-12** presents additional point sources associated with a future terminal building (Terminal 3) at McCarran International Airport. The Terminal 3 point sources were included in the 2013 and 2018 emissions estimates. **Tables III-13** through **III-18** present summaries of point sources at North Las Vegas Airport, Henderson Executive Airport, Jean Airport, Perkins Field Airport, the Heliport, and Ivanpah Airport, respectively. The tables also provide information regarding the volume of fuel consumed by the various point sources at each airport and the Heliport.

Table III-11

Point Source Data, McCarran International Airport

Source	Category	Type	Annual Consumption (kiloliters)
Fire Department Tank 1	Fuel Tank	Fuel Oil / Diesel	2.80
Fire Department Tank 2	Fuel Tank	Fuel Oil / Diesel	0.70
Fire Department Generator 1	Power / Heat Plant	Diesel	2.80
Fire Department Generator 2	Power / Heat Plant	Diesel	0.70
Bridge Area Generator	Power / Heat Plant	Diesel	1.40
Bridge Area Tank	Fuel Tank	Fuel Oil / Diesel	1.40
CIT Generator	Power / Heat Plant	Diesel	0.98
CIT Tank	Fuel Tank	Fuel Oil / Diesel	0.98
Degreasers	Solvent Degreaser	Open-Top Vapor	7.37
East Airfield Generator	Power / Heat Plant	Diesel	0.70
East Airfield Tank	Fuel Tank	Fuel Oil / Diesel	0.70
Heating and Refrigeration Plant 1	Power / Heat Plant	Diesel	16.82
Heating and Refrigeration Plant 2	Power / Heat Plant	Diesel	16.82
Heating and Refrigeration Tank 1	Fuel Tank	Fuel Oil / Diesel	16.82
Heating and Refrigeration Tank 2	Fuel Tank	Fuel Oil / Diesel	16.82
North Finger Generator	Power / Heat Plant	Diesel	0.84
North Finger Tank	Fuel Tank	Fuel Oil / Diesel	0.84
Paint Booth 1	Surface Coating	Enamel, Air Dry	0.09
Paint Booth 2	Surface Coating	Lacquer, Spraying	0.09
Paint Booth 3	Solvent Degreaser	Open-Top Vapor	0.01
Paint Booth 4	Surface Coating	Primer Surfacer	0.05
Rotunda Generator	Power / Heat Plant	Diesel	1.40
Rotunda Tank	Fuel Tank	Fuel Oil / Diesel	1.40
Satellite 1 Generator	Power / Heat Plant	Diesel	2.10
Satellite 1 Tank	Fuel Tank	Fuel Oil / Diesel	2.10
South Finger Generator	Power / Heat Plant	Diesel	8.41
South Finger Tank	Fuel Tank	Fuel Oil / Diesel	8.41
Vehicle Tank 1	Fuel Tank	Fuel Oil / Diesel	75.71
Vehicle Tank 2	Fuel Tank	Automobile Gasoline	738.16

Source: Ricondo & Associates, Inc., based on information contained in the *Final Supplemental Environmental Assessment for the Construction of Terminal 3 at McCarran International Airport*, September 2005.

Prepared by: Ricondo & Associates, Inc.

Table III-12

Point Source Data — Terminal 3, McCarran International Airport

Source	Category	Type	Annual Consumption (kiloliters)
Terminal 3 Degreasers	Solvent Degreaser	Open-Top Vapor	7.19
Terminal 3 Generator 1	Power / Heat Plant	Diesel	0.84
Terminal 3 Generator 2	Power / Heat Plant	Diesel	1.40
Terminal 3 Generator 3	Power / Heat Plant	Diesel	8.41
Terminal 3 Heating and Refrigeration Plant 1	Power / Heat Plant	Diesel	16.82
Terminal 3 Heating and Refrigeration Plant 2	Power / Heat Plant	Diesel	16.82
Terminal 3 Heating and Refrigeration Tank 1	Fuel Tank	Fuel Oil / Diesel	16.82
Terminal 3 Heating and Refrigeration Tank 2	Fuel Tank	Fuel Oil / Diesel	16.82
Terminal 3 Paint Booth 1	Surface Coating	Enamel, Air Dry	0.09
Terminal 3 Paint Booth 2	Surface Coating	Lacquer, Spraying	0.09
Terminal 3 Paint Booth 3	Solvent Degreaser	Open-Top Vapor	0.01
Terminal 3 Paint Booth 4	Surface Coating	Primer Surfacer	0.05
Terminal 3 Tank 1	Fuel Tank	Fuel Oil / Diesel	0.84
Terminal 3 Tank 2	Fuel Tank	Fuel Oil / Diesel	1.40
Terminal 3 Tank 3	Fuel Tank	Fuel Oil / Diesel	8.41
Terminal 3 Vehicle Tank 1	Fuel Tank	Fuel Oil / Diesel	75.71
Terminal 3 Vehicle Tank 2	Fuel Tank	Automobile Gasoline	738.16

Note:
Point sources associated with future Terminal 3 were included in the 2013 and 2018 airport emissions inventories.

Source: Ricondo & Associates, Inc., based on information contained in the *Final Supplemental Environmental Assessment for the Construction of Terminal 3 at McCarran International Airport*, September 2005.
Prepared by: Ricondo & Associates, Inc.

Table III-13

Point Source Data, North Las Vegas Airport

Emission Source	Type	Annual Consumption (kiloliters)
Light Trailer Generator	Diesel Fuel	0.38
ATCT Emergency Backup Generator	Diesel Fuel	1.51
80 Octane Fuel Truck	Gasoline	118.23
Jet A Tank #1	Jet A Fuel	1,741.65
Jet A Tank #2	Jet A Fuel	331.49
Jet A Tank #3	Jet A Fuel	3,930.99
Low Lead Fuel Truck	Aviation Gasoline	1,493.84
Low Lead Fuel Truck #2	Aviation Gasoline	380.43
Low Lead Fuel Truck #3	Aviation Gasoline	1,166.65
Low Lead Fuel Truck #4	Aviation Gasoline	351.91
Low Lead Fuel Truck #5	Aviation Gasoline	307.05
Low Lead Fuel Tank	Aviation Gasoline	3,971.36
Low Lead Fuel Tank #2	Aviation Gasoline	3,971.36
Unleaded Tank	Gasoline	43.03

Note:
ATCT = Airport traffic control tower

Source: Ricondo & Associates, Inc. *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports*. April 2004
Prepared by: Ricondo & Associates, Inc.

Table III-14

Point Source Data, Henderson Executive Airport

Emission Source	Type	Annual Consumption (kiloliters)
Jet A Tank #1	Jet A Fuel	1,803.99
Jet A Tank #2	Jet A Fuel	1,803.99
Avgas Tank #1	Aviation Gasoline	360.15
Avgas Tank #2	Aviation Gasoline	966.12
Gasoline Storage Tank	Gasoline	21.32

Source: Ricondo & Associates, Inc. *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports*. April 2004
Prepared by: Ricondo & Associates, Inc.

Table III-15

Point Source Data, Jean Airport

Emission Source	Type	Annual Consumption (kiloliters)
Self-Serve Fuel Island	Aviation Gasoline	146.345

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation, January 2006.
Prepared by: Ricondo & Associates, Inc.

Table III-16

Point Source Data, Perkins Field Airport

Emission Source	Type	Annual Consumption (kiloliters)
Fuel Pump	Aviation Gasoline	38.050
Future Self-Serve Fuel Island	Aviation Gasoline	38.050

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation, January 2006.
Prepared by: Ricondo & Associates, Inc.

Table III-17

Point Source Data, South of Sloan Regional Heliport

Emission Source	Type	Annual Consumption (kiloliters)
Fuel Tank	Jet Kerosene	8,394.680

Source: Ricondo & Associates, Inc., *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport*, January 2006.
Prepared by: Ricondo & Associates, Inc.

Table III-18

Point Source Data, Ivanpah Airport

Emission Source	Category	Type	Annual Consumption
Boiler #1	Boiler	Diesel	3,981.80 thousands of m^3
Boiler #2	Boiler	Diesel	3,981.80 thousands of m^3
Emergency Generators (1-13)	Generator	Diesel	68.18 kiloliters

Note:
m^3 = cubic meters

Source: MWH Americas, Inc. *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport.* July 22, 2005.
Prepared by: Ricondo & Associates, Inc.

3.5 Ground Access Vehicles

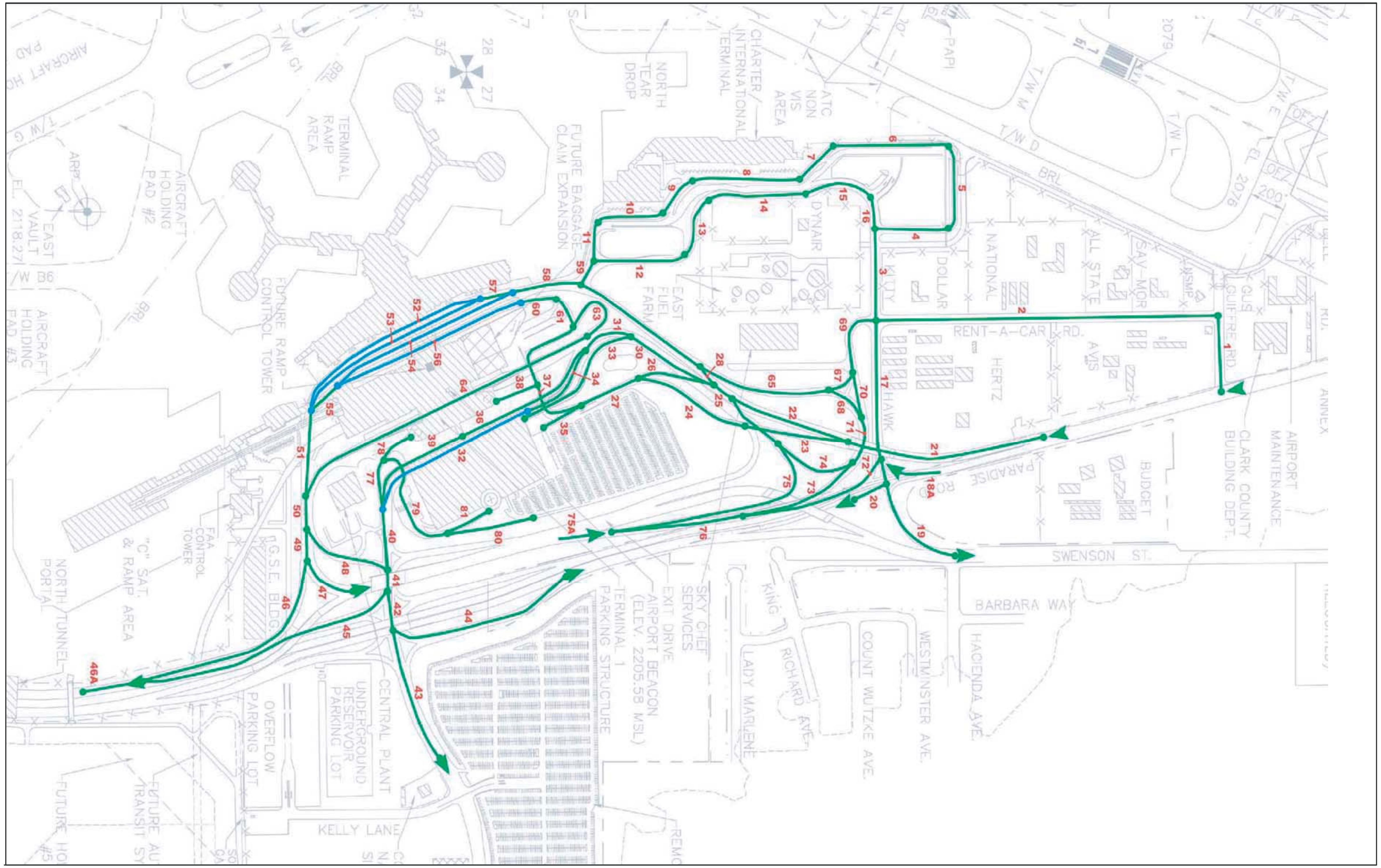
Motor vehicle traffic (on airport roadways and in airport parking lots and garages) can be a significant source of air pollutant emissions at an airport. The methodology used to model ground access vehicle emissions at McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, Perkins Field Airport, the Heliport, and Ivanpah Airport is summarized below. For purposes of the emissions inventories, only on-airport/heliport vehicle trips were modeled in EDMS. It was assumed that offsite aviation-related traffic is accounted for in the Regional Transportation Commission's regional travel demand model.

3.5.1 Motor Vehicle Volumes – McCarran International Airport

Exhibit III-1 depicts the terminal area roadway segments associated with Terminal 1 and Terminal 2 at McCarran International Airport. **Exhibit III-2** depicts a potential roadway scheme for the future Terminal 3 at McCarran International Airport. Roadway segments associated with Terminal 3, as depicted on Exhibit III-2, were included only in the 2013 and 2018 emissions estimates. Vehicle trips on the west side of McCarran International Airport by general aviation tenants and customers, and cargo vehicle trips on Spencer Street (not shown on either exhibit) were also modeled in the EDMS.

Table III-19 provides detailed information regarding each roadway segment modeled in the EDMS including: segment length, assumed vehicle speed, and assumed annual traffic volume. As noted in Table III-19, roadway segments 8, 32, 52, 53, 54, 56, 64, and 99 were modeled as parking lots in the EDMS to account for vehicle dwell times at the terminal curbsides. Average vehicle idle times and annual traffic volumes associated with the terminal curbsides and airport parking lots are summarized in **Table III-20**.

Traffic volumes for Terminal 3 roadways and parking lots were based on information contained in earlier planning studies and the *Final Supplemental Environmental Assessment for the Construction of Terminal 3 at McCarran International Airport*.



Legend

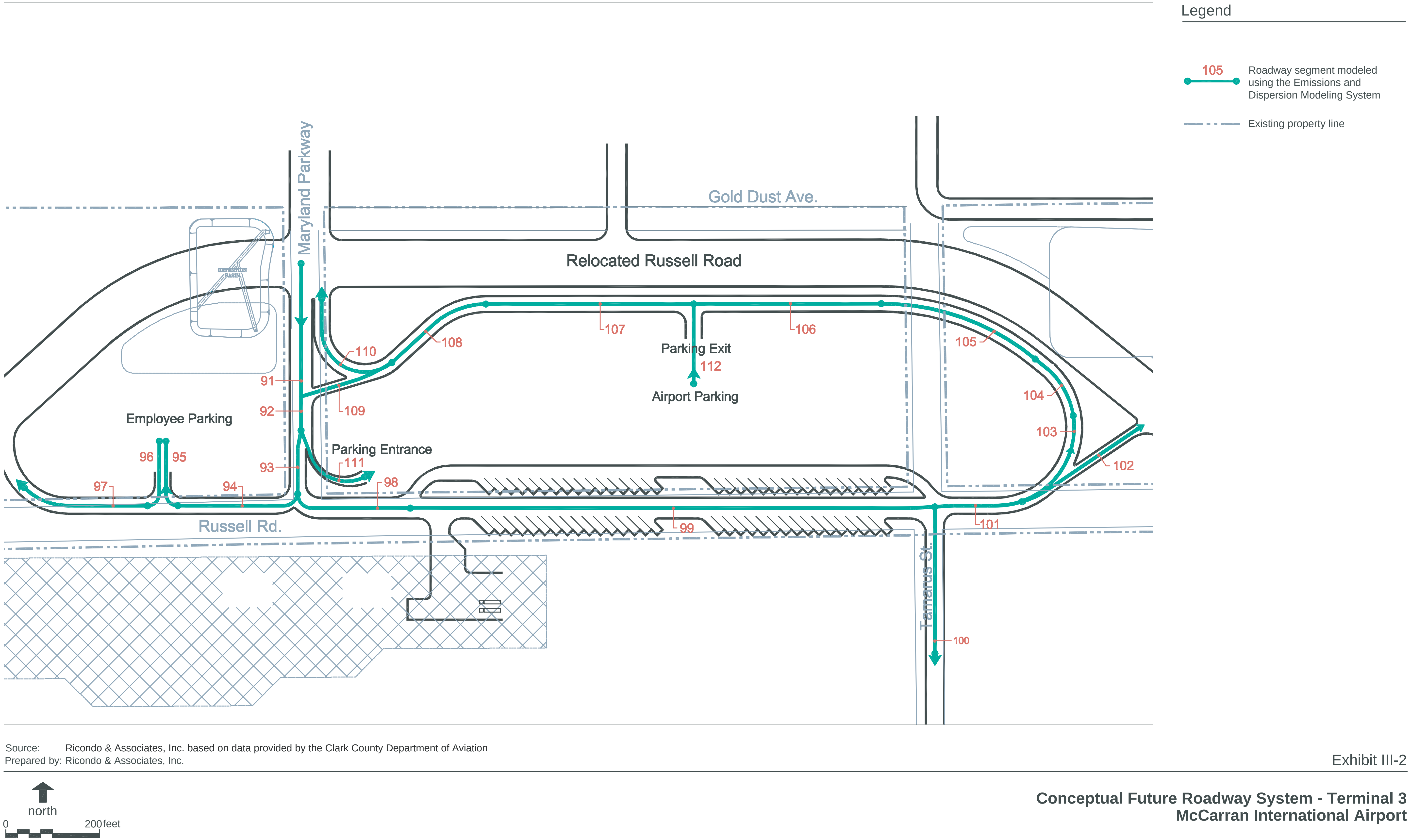
- 24 — Roadway segment modeled using the Emissions and Dispersion Modeling System
- 52 — Roadway segment modeled as a parking lot or curbside

Source: Ricondo & Associates, Inc. based on data provided by the Clark County Department of Aviation
Prepared by: Ricondo & Associates, Inc.

Exhibit III-1

north
0 600 feet

Modeled Terminal Area Roadway Segments
McCarran International Airport



Source: Ricondo & Associates, Inc. based on data provided by the Clark County Department of Aviation
Prepared by: Ricondo & Associates, Inc.

Exhibit III-2

Conceptual Future Roadway System - Terminal 3
McCarran International Airport

Table III-19 (1 of 3)

Roadway Segments Modeled in EDMS, McCarran International Airport

Segment Number [1/]	Segment Length (miles)	Vehicle Speed (miles per hour)	Annual Traffic Volume				
			2002	2003	2008	2013	2018
1	0.080	20	258,119	267,317	335,727	285,713	281,114
2	0.361	20	258,119	267,317	335,727	285,713	281,114
3	0.081	20	1,330,837	1,330,837	1,525,594	1,493,135	1,655,432
4	0.090	20	713,831	713,831	818,294	800,883	887,936
5	0.088	20	713,831	713,831	818,294	800,883	887,936
6	0.131	20	713,831	713,831	818,294	800,883	887,936
7	0.044	20	713,831	713,831	818,294	800,883	887,936
8 [2/]	—	—	—	—	—	—	—
9	0.039	20	713,831	713,831	818,294	800,883	887,936
10	0.077	20	713,831	713,831	818,294	800,883	887,936
11	0.038	20	713,831	713,831	818,294	800,883	887,936
12	0.097	20	736,727	736,727	844,541	826,572	916,416
13	0.062	20	736,727	736,727	844,541	826,572	916,416
13a [3/]	—	—	—	—	—	—	—
14	0.120	20	736,727	736,727	844,541	826,572	916,416
15	0.063	10	736,727	736,727	844,541	826,572	916,416
16	0.052	10	736,727	736,727	844,541	826,572	916,416
17	0.147	20	1,618,941	1,639,673	1,945,645	1,807,619	1,923,734
18	0.017	20	676,867	676,867	775,921	759,412	841,956
18a	0.100	20	822,646	841,042	1,022,703	915,201	943,370
19	0.101	30	392,583	392,583	450,034	440,459	488,335
20	0.124	30	284,284	284,284	325,887	318,953	353,622
21	0.125	30	4,081,613	4,237,979	5,356,110	4,513,344	4,397,794
22	0.050	30	2,897,375	3,007,300	3,797,444	3,204,296	3,126,480
23	0.099	30	1,184,238	1,230,679	1,558,666	1,309,047	1,271,314
24	0.102	30	1,184,238	1,230,679	1,558,666	1,309,047	1,271,314
25	0.087	30	5,248,896	5,451,038	6,892,461	5,803,649	5,650,907
26	0.081	30	1,607,581	1,670,623	2,115,860	1,777,007	1,725,785
27	0.073	30	2,791,819	2,901,302	3,674,526	3,086,055	2,997,100
28	0.022	30	1,770,530	1,836,266	2,314,318	1,958,692	1,916,779
29	0.145	30	3,473,356	3,605,869	4,555,538	3,840,982	3,744,813
30	0.118	30	1,870,785	1,944,149	2,462,283	2,067,951	2,008,342
31	0.029	30	1,870,785	1,944,149	2,462,283	2,067,951	2,008,342
32 [2/]	—	—	—	—	—	—	—
33	0.120	15	353,578	367,444	465,371	390,843	379,577
33a [3/]	—	—	—	—	—	—	—
34	0.118	15	665,999	692,117	876,573	736,190	714,970
35	0.041	20	857,088	890,700	1,128,080	947,419	920,110
35a [3/]	—	—	—	—	—	—	—
36	0.153	15	851,207	884,588	1,120,339	940,917	913,796
36a [3/]	—	—	—	—	—	—	—

Table III-19 (2 of 3)

Roadway Segments Modeled in EDMS, McCarran International Airport

Segment Number [1/]	Segment Length (miles)	Vehicle Speed (miles per hour)	Annual Traffic Volume				
			2002	2003	2008	2013	2018
37	0.048	20	1,934,730	2,010,602	2,546,447	2,138,636	2,076,990
38	0.015	15	448,857	466,460	590,776	496,164	481,862
38a [3/]	—	—	—	—	—	—	—
39	0.140	15	851,207	884,588	1,120,339	940,917	913,796
40	0.032	20	3,176,730	3,301,308	4,181,138	3,511,533	3,410,313
41	0.037	25	3,571,482	3,711,316	4,699,731	3,947,983	3,835,064
42	0.033	30	2,491,394	2,588,872	3,278,144	2,754,062	2,675,558
43	0.045	30	259,849	269,815	341,037	287,330	279,929
44	0.187	30	1,842,504	1,914,759	2,425,060	2,036,689	1,977,982
45	0.254	30	1,080,088	1,122,445	1,421,587	1,193,921	1,159,507
46	0.199	30	1,677,695	1,742,535	2,204,021	1,854,913	1,805,190
46a	0.020	25	2,757,784	2,864,980	3,625,608	3,048,834	2,964,697
47	0.058	30	2,861,951	2,972,561	3,759,801	3,164,264	3,079,442
48	0.087	20	394,752	410,008	518,593	436,450	424,751
49	0.023	30	4,539,646	4,715,096	5,963,822	5,019,177	4,884,632
50	0.044	30	4,934,398	5,125,104	6,482,415	5,455,627	5,309,383
51	0.075	25	4,524,831	4,699,476	5,943,353	5,002,895	4,869,701
52 [2/]	—	—	—	—	—	—	—
53 [2/]	—	—	—	—	—	—	—
54 [2/]	—	—	—	—	—	—	—
55	0.036	15	1,652,616	1,714,625	2,163,011	1,827,971	1,786,293
56 [2/]	—	—	—	—	—	—	—
57	0.018	15	2,872,215	2,984,851	3,780,342	3,174,924	3,083,407
58	0.063	20	3,450,460	3,582,972	4,529,290	3,815,293	3,716,332
59	0.033	20	165,663	165,663	189,906	185,865	206,068
60	0.052	20	1,074,371	1,116,504	1,414,062	1,187,602	1,153,369
61	0.030	20	1,074,371	1,116,504	1,414,062	1,187,602	1,153,369
62	0.048	20	1,483,938	1,542,132	1,953,125	1,640,334	1,593,051
63	0.019	20	409,567	425,628	539,062	452,732	439,682
64 [2/]	—	—	—	—	—	—	—
65	0.230	30	1,702,826	1,769,603	2,241,219	1,882,290	1,828,034
66	0.070	30	1,702,826	1,769,603	2,241,219	1,882,290	1,828,034
67	0.023	30	320,550	333,121	421,901	354,334	344,120
68	0.029	30	1,382,275	1,436,482	1,819,318	1,527,956	1,483,913
69	0.064	20	763,215	793,145	1,004,526	843,652	819,334
70	0.028	20	659,657	677,017	831,372	732,773	745,131
71	0.058	20	2,041,933	2,113,499	2,650,691	2,260,730	2,229,044
72	0.087	30	119,428	121,764	147,022	133,006	138,408
73	0.064	30	1,599,268	1,653,475	2,068,066	1,771,411	1,753,831
74	0.075	25	2,794,186	2,903,762	3,677,642	3,088,671	2,999,641
75	0.062	25	1,908,857	1,983,714	2,512,392	2,110,035	2,049,214

Table III-19 (3 of 3)

Roadway Segments Modeled in EDMS, McCarran International Airport

Segment Number [1/]	Segment Length (miles)	Vehicle Speed (miles per hour)	Annual Traffic Volume				
			2002	2003	2008	2013	2018
75a	0.020	25	3,508,125	3,637,189	4,580,458	3,881,447	3,803,045
76	0.044	30	1,599,268	1,653,475	2,068,066	1,771,411	1,753,831
77	0.076	15	1,659,524	1,724,604	2,184,227	1,834,425	1,781,548
78	0.190	15	448,857	466,460	590,776	496,164	481,862
79	0.087	20	1,210,667	1,258,144	1,593,451	1,338,261	1,299,686
80	0.148	20	857,088	890,700	1,128,080	947,419	920,110
81	0.077	20	353,578	367,444	465,371	390,843	379,577
82 [4/]	0.258	20	188,498	196,698	243,367	301,110	357,022
83 [4/]	0.365	20	824,680	860,554	1,064,732	1,317,354	1,561,969
91 [4/, 5/]	0.042	20	n.a.	n.a.	n.a.	3,120,750	4,635,500
92 [4/, 5/]	0.018	20	n.a.	n.a.	n.a.	3,370,410	5,006,340
93 [4/, 5/]	0.024	20	n.a.	n.a.	n.a.	3,089,543	4,589,145
94 [4/, 5/]	0.046	15	n.a.	n.a.	n.a.	280,868	417,195
95 [4/, 5/]	0.014	15	n.a.	n.a.	n.a.	280,868	417,195
95a [3/]	—	—	n.a.	n.a.	n.a.	—	—
96 [4/, 5/]	0.014	15	n.a.	n.a.	n.a.	280,868	417,195
97 [4/, 5/]	0.053	20	n.a.	n.a.	n.a.	280,868	417,195
98 [4/, 5/]	0.045	15	n.a.	n.a.	n.a.	2,808,675	4,171,950
99 [2/, 5/]	—	—	n.a.	n.a.	n.a.	—	—
100 [4/, 5/]	—	—	n.a.	n.a.	n.a.	—	—
101 [4/, 5/]	0.070	20	n.a.	n.a.	n.a.	2,808,675	4,171,950
102 [4/, 5/]	0.022	20	n.a.	n.a.	n.a.	719,021	1,068,019
103 [4/, 5/]	0.060	20	n.a.	n.a.	n.a.	2,089,654	3,103,931
104 [4/, 5/]	0.040	20	n.a.	n.a.	n.a.	2,089,654	3,103,931
105 [4/, 5/]	0.042	20	n.a.	n.a.	n.a.	2,089,654	3,103,931
106 [4/, 5/]	0.100	15	n.a.	n.a.	n.a.	2,089,654	3,103,931
107 [4/, 5/]	0.091	20	n.a.	n.a.	n.a.	2,370,522	3,521,126
108 [4/, 5/]	0.053	20	n.a.	n.a.	n.a.	2,370,522	3,521,126
109 [4/, 5/]	0.024	15	n.a.	n.a.	n.a.	249,660	370,840
110 [4/, 5/]	0.036	20	n.a.	n.a.	n.a.	2,120,862	3,150,286
111 [4/, 5/]	0.030	15	n.a.	n.a.	n.a.	280,868	417,195
111a [3/]	—	—	n.a.	n.a.	n.a.	—	—
112 [4/, 5/]	0.012	15	n.a.	n.a.	n.a.	280,868	417,195

Notes:

n.a. = Not applicable.

1/ See Exhibits III-1 (existing) and III-2 (future Terminal 3).

2/ Roadway segments 8, 32, 52, 53, 54, 56, 64, and 99 were modeled as parking lots to account for dwell time at the curbside. Traffic volumes are presented in Table III-20.

3/ Placeholder for airport parking areas. Traffic volumes are presented in Table III-20.

4/ Not shown on Exhibit III-1.

5/ Roadway network associated with the future Terminal 3 (Exhibit III-2).

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.

Prepared by: Ricondo & Associates, Inc.

Table III-20

Parking Lot and Curbside Traffic Volumes, McCarran International Airport

Segment Number	Lot Name	Type [1/]	Idle Time (minutes)	Annual Traffic Volume 2002	2003	2008	2013	2018
8	Terminal 2	Curbside	3.5	1,427,661	1,427,661	1,636,587	1,601,766	1,775,871
13a	Terminal 2	Parking	1.5	265,222	265,222	304,035	297,566	329,910
32	Arrival	Arrival Curbside	3.0	1,331,999	1,384,234	1,753,145	1,472,381	1,429,940
33a	Gold Garage	Long Term	1.5	707,157	734,888	930,743	781,685	759,153
35a	Oversize Surface	Employee	1.5	1,714,177	1,781,399	2,256,159	1,894,838	1,840,219
36a	Silver Garage	Short Term	1.5	1,702,414	1,769,175	2,240,677	1,881,835	1,827,591
38a	Zero Level	Group Movements	3.5	897,715	932,919	1,181,551	992,327	963,723
52	West Departure	Departure Curbside	2.8	4,595,544	4,775,762	6,048,547	5,079,879	4,933,452
53	East Departure	Departure Curbside	2.8	1,148,886	1,193,940	1,512,137	1,269,970	1,233,363
54	Courtesy	Courtesy Curbside	3.3	1,156,489	1,196,243	1,497,897	1,280,738	1,265,849
56	Taxi	Taxicab Curbside	3.5	2,148,743	2,233,007	2,828,125	2,375,203	2,306,738
64	Per Capita	Curbside	3.5	819,134	851,257	1,078,125	905,464	879,364
95a [2/]	Terminal 3	Employee	1.5	n.a.	n.a.	n.a.	561,735	834,390
99 [2/]	Terminal 3	Curbside	1.7	n.a.	n.a.	n.a.	5,617,350	8,343,900
111a [2/]	Terminal 3	Public	1.5	n.a.	n.a.	n.a.	561,735	834,390
82 [3/]	Spencer	Air Cargo Parking	1.5	1,649,361	1,721,108	2,129,464	2,634,709	3,123,938
83 [3/]	West Side	West Side Parking	1.5	376,997	393,396	486,735	602,219	714,043

Notes:
n.a. = Not applicable.
1/ Terminal curbsides were modeled as parking lots.
2/ Parking and curbside areas associated with future Terminal 3 were assumed to be operational by 2013.
3/ Not shown on Exhibit III-1.

Source: Ricondo & Associates, Inc. based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

3.5.2 Motor Vehicle Volumes – Other Airports

Airport roadway segments and parking lots at North Las Vegas Airport, Henderson Executive Airport, Jean Airport, Perkins Field Airport, the Heliport, and Ivanpah Airport were also modeled in the EDMS. Counts of on-road motor vehicle trips and traffic volumes associated with parking lots at each airport are summarized in **Tables III-21** through **III-26**, respectively.

Vehicle trips associated with general aviation tenants and commercial (air tour) tenants at North Las Vegas Airport and Henderson Executive Airport were estimated separately. Roadway traffic volumes for North Las Vegas Airport and Henderson Executive Airport in 2002 were based on FAA ATCT operations summaries obtained from the Department of Aviation and information contained in the *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports.*

Table III-21

Motor Vehicle Traffic Volumes, North Las Vegas Airport

	2002	2003	2008	2013	2018
Average Daily Air Tour Passengers	395	626	551	618	700
Average Daily Aircraft Operations 1/	598	623	619	639	669
Vehicle Trip Ends per Day					
Generated by Air Tour Passengers					
Air Tour 1 2/	53	83	73	82	93
Air Tour 2 3/	9	15	13	15	17
Total	62	98	87	97	110
Generated by Aircraft Operations 4/	1,549	1,614	1,603	1,655	1,733
Total Daily Vehicle Trips	1,611	1,712	1,690	1,752	1,843
Annual Traffic Volume	587,975	624,859	616,775	639,525	672,589

Notes:

Columns may not add to totals shown because of rounding.

1/ Data for analysis years 2008, 2013, and 2018 were obtained from the *Draft Southern Nevada Airport System Plan Update*, December 2005.

2/ Air Tour 1 was assumed to accommodate 75 percent of total daily air tour passengers. Each bus was assumed to have 15 seats and a 75 percent load factor.

3/ Air Tour 2 was assumed to accommodate 25 percent of total daily air tour passengers. Each bus was assumed to have 30 seats and a 70 percent load factor.

4/ Assumed 2.59 vehicle trip ends per aircraft operation. Based on the Institute of Transportation Engineers*, Trip Generation Manual,* Fifth Edition **[III-11]**.

Sources: Ricondo & Associates, Inc. based on information contained in the *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports* except as noted above.

Prepared by: Ricondo & Associates, Inc.

Table III-22

Motor Vehicle Traffic Volumes, Henderson Executive Airport

	2002	2003	2008	2013	2018
Average Daily Air Tour Passengers	137	74	88	100	113
Average Daily Aircraft Operations [1/]	207	201	285	380	473
Vehicle Trip Ends per Day					
Generated by Air Tour Passengers					
Air Tour 1 [2/]	6	3	4	4	5
Air Tour 2 [3/]	7	4	5	5	6
Total	13	7	9	10	11
Generated by Aircraft Operations [4/]	536	521	738	984	1,225
Total Daily Vehicle Trips	550	528	747	994	1,236
Annual Traffic Volume	200,577	192,656	272,565	362,802	451,183

Notes:

Columns may not add to totals shown because of rounding.

1/ Data for analysis years 2008, 2013, and 2018 were obtained from the *Draft Southern Nevada Airport System Plan Update*, December 2005.

2/ Air Tour 1 was assumed to accommodate 20 percent of total daily air tour passengers. Each bus was assumed to have 15 seats and a 60 percent load factor.

3/ Air Tour 2 was assumed to accommodate 80 percent of total daily air tour passengers. Each bus was assumed to have 30 seats and a 60 percent load factor.

4/ Assumed 2.59 vehicle trip ends per aircraft operation. Based on the Institute of Transportation Engineers, *Trip Generation Manual,* Fifth Edition.

Sources: Ricondo & Associates, Inc. based on information contained in the *2002 Airport Emissions Inventories McCarran International, North Las Vegas, and Henderson Executive Airports* except as noted above.

Prepared by: Ricondo & Associates, Inc.

Table III-23

Motor Vehicle Traffic Volumes, Jean Airport

	2002	2003	2008	2013	2018
Average Daily Air Tour passengers	0	0	0	0	0
Average Daily Aircraft Operations [1/]	55	55	55	55	55
Vehicle Trip Ends per Day					
Generated by Aircraft Operations [2/]	142	142	142	142	142
Total Daily Vehicle Trips	142	142	142	142	142
Annual Traffic Volume	51,994	51,994	51,994	51,994	51,994

Notes:

1/ Data for analysis years 2008, 2013, and 2018 were obtained from the *Draft Southern Nevada Airport System Plan Update*, December 2005.

2/ Assumed 2.59 vehicle trip ends per aircraft operation. Based on the Institute of Transportation Engineers, *Trip Generation Manual,* Fifth Edition.

Source: Ricondo & Associates, Inc. based on information noted above.

Prepared by: Ricondo & Associates, Inc.

Table III-24

Motor Vehicle Traffic Volumes, Perkins Field Airport

	2002	2003	2008	2013	2018
Average Daily Air Tour Passengers	0	0	0	0	0
Average Daily Aircraft Operations [1/]	14	14	14	14	14
Vehicle Trip Ends per Day Generated by Aircraft Operations [2/]	36	36	36	36	36
Total Daily Vehicle Trips	36	36	36	36	36
Annual Traffic Volume	13,235	13,235	13,235	13,235	13,235

Notes:

1/ Data for analysis years 2008, 2013, and 2018 were obtained from the *Draft Southern Nevada Airport System Plan Update*, December 2005.

2/ Assumed 2.59 vehicle trip ends per aircraft operation. Based on the Institute of Transportation Engineers*, Trip Generation Manual,* Fifth Edition.

Sources: Ricondo & Associates, Inc. based on information noted above.
Prepared by: Ricondo & Associates, Inc.

Table III-25

Motor Vehicle Traffic Volumes, South of Sloan Regional Heliport

	2013	2018
Annual Traffic Volume [1/]	42,675	53,975

Note:

1/ A ratio of one vehicle operation to 1.6 Grand Canyon helicopter operations was assumed. Years 2009 and 2015 were used to represent motor vehicle traffic volumes in 2013 and 2018, respectively.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table III-26

Motor Vehicle Traffic Volumes, Ivanpah Airport

	2018
Annual Traffic Volume [1/]	11,703,725

Note:

1/ A total of 32,065 vehicle trip ends per day was assumed. Year 2025 forecast data were used to represent annual traffic volumes in 2018.

Source: Ricondo & Associates, Inc. based on information contained in MWH Americas, Inc.'s *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.
Prepared by: Ricondo & Associates, Inc.

3.5.3 Motor Vehicle Emission Factors

MOBILE6.2 emission factors developed by the DAQEM were used in lieu of emission factors incorporated in the EDMS database to model emissions from on-road motor vehicles for all Clark County Airport System airports except the proposed Ivanpah Airport, for which EDMS default data were used. The DAQEM emission factors more accurately represent conditions in the Las Vegas metropolitan area. **Table III-27** presents emission factors, expressed in grams per vehicle mile, for motor vehicles operating on airport roadways for all seven facilities.

Table III-27 (1 of 2)

On-Airport Roadway Motor Vehicle Emission Factors

Year	Speed (mph)	Emission Factors by Pollutant (grams per vehicle mile)					
		CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$
2002	2.5	44.463	17.828	2.988	0.0325	0.0385	0.0235
	5	25.880	6.420	2.584	0.0325	0.0385	0.0235
	10	17.523	3.376	2.085	0.0325	0.0385	0.0235
	15	15.401	2.531	1.780	0.0325	0.0385	0.0235
	20	14.293	1.977	1.615	0.0325	0.0384	0.0235
	25	13.902	1.785	1.512	0.0326	0.0383	0.0233
	30	13.872	1.653	1.446	0.0326	0.0381	0.0231
	35	14.181	1.548	1.415	0.0327	0.0379	0.0229
	40	14.972	1.474	1.430	0.0327	0.0379	0.0229
	45	15.782	1.411	1.460	0.0327	0.0379	0.0229
	50	16.609	1.358	1.504	0.0327	0.0379	0.0229
	55	17.452	1.320	1.566	0.0327	0.0379	0.0229
	60	18.396	1.294	1.65	0.0327	0.0379	0.0229
	65	19.364	1.275	1.766	0.0327	0.0379	0.0229
	Road Dust					**2.6300**	
2003	2.5	40.139	16.417	2.776	0.0325	0.0374	0.0225
	5	23.344	5.878	2.399	0.0325	0.0374	0.0225
	10	15.862	3.088	1.928	0.0325	0.0374	0.0225
	15	13.959	2.319	1.640	0.0325	0.0374	0.0225
	20	12.975	1.817	1.484	0.0325	0.0373	0.0225
	25	12.629	1.641	1.387	0.0326	0.0371	0.0225
	30	12.612	1.521	1.325	0.0327	0.0369	0.0225
	35	12.908	1.425	1.295	0.0327	0.0368	0.0225
	40	13.647	1.358	1.310	0.0327	0.0368	0.0225
	45	14.403	1.301	1.341	0.0327	0.0368	0.0225
	50	15.174	1.252	1.385	0.0327	0.0368	0.0225
	55	15.960	1.217	1.446	0.0327	0.0368	0.0225
	60	16.844	1.194	1.528	0.0327	0.0368	0.0225
	65	17.748	1.176	1.640	0.0327	0.0368	0.0225
	Road Dust					**2.6300**	
2008	2.5	22.540	10.838	1.638	0.0082	0.0312	0.0168
	5	13.576	3.806	1.412	0.0082	0.0312	0.0168
	10	9.285	1.990	1.133	0.0082	0.0312	0.0168
	15	8.040	1.496	0.962	0.0082	0.0312	0.0168
	20	7.324	1.173	0.869	0.0082	0.0312	0.0168
	25	7.036	1.059	0.811	0.0082	0.0312	0.0168
	30	6.949	0.982	0.774	0.0082	0.0311	0.0168
	35	7.050	0.920	0.757	0.0083	0.0311	0.0167
	40	7.415	0.875	0.766	0.0083	0.0311	0.0167
	45	7.794	0.836	0.785	0.0083	0.0311	0.0167
	50	8.184	0.803	0.813	0.0083	0.0311	0.0167
	55	8.587	0.779	0.851	0.0083	0.0311	0.0167
	60	9.083	0.763	0.902	0.0083	0.0311	0.0167
	65	9.594	0.752	0.973	0.0083	0.0311	0.0167
	Road Dust					**2.3200**	

Table III-27 (2 of 2)

On-Airport Roadway Motor Vehicle Emission Factors

Year	Speed (mph)	Emission Factors by Pollutant (grams per vehicle mile)					
		CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$
2013	2.5	16.078	6.035	0.926	0.0082	0.0277	0.0137
	5	9.887	2.293	0.796	0.0082	0.0277	0.0137
	10	6.792	1.262	0.636	0.0082	0.0277	0.0137
	15	5.818	0.947	0.538	0.0082	0.0277	0.0137
	20	5.235	0.726	0.486	0.0082	0.0277	0.0137
	25	4.983	0.66	0.454	0.0082	0.0277	0.0136
	30	4.893	0.613	0.433	0.0083	0.0277	0.0136
	35	4.933	0.576	0.423	0.0083	0.0277	0.0136
	40	5.185	0.548	0.428	0.0083	0.0277	0.0136
	45	5.447	0.523	0.438	0.0083	0.0277	0.0136
	50	5.719	0.504	0.451	0.0083	0.0277	0.0136
	55	6.000	0.493	0.470	0.0083	0.0277	0.0136
	60	6.373	0.487	0.494	0.0083	0.0277	0.0136
	65	6.756	0.484	0.527	0.0083	0.0277	0.0136
	Road Dust					**2.3200**	
2018	2.5	13.466	4.484	0.574	0.0082	0.0264	0.0125
	5	8.335	1.759	0.491	0.0082	0.0264	0.0125
	10	5.714	0.975	0.387	0.0082	0.0264	0.0125
	15	4.853	0.718	0.325	0.0082	0.0264	0.0125
	20	4.319	0.529	0.292	0.0082	0.0264	0.0125
	25	4.078	0.479	0.272	0.0082	0.0264	0.0124
	30	3.983	0.442	0.259	0.0083	0.0264	0.0124
	35	3.990	0.412	0.252	0.0083	0.0264	0.0124
	40	4.185	0.390	0.255	0.0083	0.0264	0.0124
	45	4.389	0.369	0.261	0.0083	0.0264	0.0124
	50	4.603	0.355	0.269	0.0083	0.0264	0.0124
	55	4.826	0.347	0.279	0.0083	0.0264	0.0124
	60	5.141	0.345	0.292	0.0083	0.0264	0.0124
	65	5.467	0.344	0.310	0.0083	0.0264	0.0124
	Road Dust					**2.3200**	

Note:
mph = Miles per hour

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Air Quality and Environmental Management.
Prepared by: Ricondo & Associates, Inc.

IV. Emissions Inventories

EDMS version 4.3 was used to calculate emissions at each of the airport facilities for the years noted. **Tables IV-1** through **IV-25** summarize the annual emissions inventories conducted for McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, and Perkins Field Airport in 2002, 2003, 2008, 2013, and 2018, respectively. **Tables IV-26** and **IV-27** summarize the annual emissions inventories conducted for the Heliport in 2013 and 2018, and **Table IV-28** summarizes the annual emissions inventory conducted for Ivanpah Airport in 2018. The Source Classification Code (SCC) for each emission source is also presented in the tables.

As shown in the tables, aircraft and GSE operations are the primary sources of VOC and NO_X emissions at all of the airport/heliport facilities.[3] As noted earlier, estimated motor vehicle emissions in these inventories only address traffic on airport roadways and in airport parking facilities.

[3] Ground support equipment emissions were not included in the analysis conducted for Ivanpah Airport.

Table IV-1

2002 McCarran International Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	2,218.006	203.602	1,717.069	143.774	30.691	30.691	2275000000
Aircraft [1/] (6,535 feet mixing height)	2,885.480	228.117	2,896.101	222.861	49.324	49.324	2275000000
Auxiliary Power Unit	96.373	6.689	63.955	9.270	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	2,314.379	210.291	1,781.024	153.044	30.691	30.691	
Subtotal (6,535 feet mixing height)	2,981.853	234.806	2,960.056	232.131	49.324	49.324	
Ground Support Equipment							
Diesel-powered	29.690	7.698	83.487	11.441	6.796	6.593	2270008005
Gasoline-powered	7,304.647	336.010	286.138	12.817	3.360	3.088	2265008005
Subtotal	7,334.337	343.708	369.625	24.258	10.156	9.681	
On-Road Vehicles							
Roadways [2/]	274.348	35.705	29.729	0.633	61.795	0.452	2294005001
Parking Lots	309.483	50.510	21.881	0.438	0.418	0.309	2294005001
Subtotal	583.831	86.215	51.610	1.071	62.213	0.761	
Stationary Sources							
Power / Heat Plant [3/]	6.514	0.862	5.483	0.217	0.733	0.233	2101004000
Surface Coating (Prime Coat)	0.000	0.024	0.000	0.000	0.000	0.000	2401075000
Surface Coating (Topcoat)	0.000	0.118	0.000	0.000	0.000	0.000	2401075000
Solvent Degreaser	0.000	4.881	0.000	0.000	0.000	0.000	2415000000
Gasoline Tank	0.000	1.502	0.000	0.000	0.000	0.000	2501000120
Subtotal	6.514	7.387	5.483	0.217	0.733	0.233	
Total (3,000 feet mixing height)	10,239.061	647.601	2,207.742	178.590	103.793	41.366	
Total (6,535 feet mixing height)	10,906.535	672.116	3,386.774	257.677	122.426	59.999	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Total PM_{10} for roadways includes entrained road dust.

3/ Includes the central plant. The central plant was not modeled in the EDMS.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table IV-2

2003 McCarran International Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	2,356.745	171.898	1,498.480	128.809	32.878	32.878	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,272.956	195.948	2,519.678	198.392	52.616	52.616	2275000000
Auxiliary Power Unit	84.602	5.956	62.500	8.864	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	2,441.347	177.854	1,560.980	137.673	32.878	32.878	
Subtotal (6,535 feet mixing height)	3,357.558	201.904	2,582.178	207.256	52.616	52.616	
Ground Support Equipment							
Diesel-powered	29.049	7.568	87.463	12.378	6.346	6.157	2270008005
Gasoline-powered	6,601.375	306.994	264.260	11.956	3.114	2.866	2265008005
Subtotal	6,630.424	314.562	351.723	24.334	9.460	9.023	
On-Road Vehicles							
Roadways [2/]	257.691	33.927	28.195	0.656	63.910	0.450	2294005001
Parking Lots	299.022	48.827	21.531	0.584	0.423	0.310	2294005001
Subtotal	556.713	82.754	49.726	1.240	64.333	0.760	
Stationary Sources							
Power / Heat Plant [3/]	6.514	0.862	5.483	0.217	0.733	0.233	2101004000
Surface Coating (Prime Coat)	0.000	0.024	0.000	0.000	0.000	0.000	2401075000
Surface Coating (Topcoat)	0.000	0.118	0.000	0.000	0.000	0.000	2401075000
Solvent Degreaser	0.000	4.881	0.000	0.000	0.000	0.000	2415000000
Gasoline Tank	0.000	1.502	0.000	0.000	0.000	0.000	2501000120
Subtotal	6.514	7.387	5.483	0.217	0.733	0.233	
Total (3,000 feet mixing height)	9,634.998	582.557	1,967.912	163.464	107.404	42.894	
Total (6,535 feet mixing height)	10,551.209	606.607	2,989.110	233.047	127.142	62.632	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Total PM_{10} for roadways includes entrained road dust.

3/ Includes the central plant. The central plant was not modeled in the EDMS.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table IV-3

2008 McCarran International Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft 1/ (3,000 feet mixing height)	2,438.259	186.261	1,949.826	169.760	34.401	34.401	2275000000
Aircraft 1/ (6,535 feet mixing height)	3,052.629	206.158	3,252.275	256.252	54.429	54.429	2275000000
Auxiliary Power Unit	96.875	6.988	79.699	11.090	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	2,535.134	193.249	2,029.525	180.850	34.401	34.401	
Subtotal (6,535 feet mixing height)	3,149.504	213.146	3,331.974	267.342	54.429	54.429	
Ground Support Equipment							
Diesel-powered	27.450	6.995	81.941	15.859	6.835	6.634	2270008005
Gasoline-powered	8,080.209	349.248	274.445	14.821	3.825	3.522	2265008005
Subtotal	8,107.659	356.243	356.386	30.680	10.660	10.156	
On-Road Vehicles							
Roadways 2/	179.595	27.332	20.599	0.211	70.515	0.418	2294005001
Parking Lots	237.362	38.065	17.387	0.068	0.373	0.245	2294005001
Subtotal	416.957	65.397	37.986	0.279	70.888	0.663	
Stationary Sources							
Power / Heat Plant 3/	7.088	0.921	5.701	0.217	0.782	0.233	2101004000
Surface Coating (Prime Coat)	0.000	0.024	0.000	0.000	0.000	0.000	2401075000
Surface Coating (Topcoat)	0.000	0.118	0.000	0.000	0.000	0.000	2401075000
Solvent Degreaser	0.000	4.881	0.000	0.000	0.000	0.000	2415000000
Gasoline Tank	0.000	1.502	0.000	0.000	0.000	0.000	2501000120
Subtotal	7.088	7.446	5.701	0.217	0.782	0.233	
Total (3,000 feet mixing height)	11,066.838	622.335	2,429.598	212.026	116.732	45.453	
Total (6,535 feet mixing height)	11,681.208	642.232	3,732.047	298.518	136.760	65.481	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Total PM_{10} for roadways includes entrained road dust.

3/ Includes the central plant. The central plant was not modeled in the EDMS.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-4

2013 McCarran International Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	2,641.038	194.163	2,229.250	189.727	32.587	32.587	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,278.400	213.012	3,724.929	286.992	50.610	50.610	2275000000
Auxiliary Power Unit	105.112	7.743	89.959	12.489	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	2,746.150	201.906	2,319.209	202.216	32.587	32.587	
Subtotal (6,535 feet mixing height)	3,383.512	220.755	3,814.888	299.481	50.610	50.610	
Ground Support Equipment							
Diesel-powered	23.468	5.075	56.515	15.576	9.114	8.841	2270008005
Gasoline-powered	8,957.785	355.992	242.166	16.476	4.252	3.909	2265008005
Subtotal	8,981.253	361.067	298.681	32.052	13.366	12.750	
On-Road Vehicles							
Roadways [2/]	129.912	17.606	11.796	0.204	72.292	0.342	2294005001
Parking Lots	149.038	18.318	11.244	0.077	0.313	0.181	2294005001
Subtotal	278.950	35.924	23.040	0.281	72.605	0.523	
Stationary Sources							
Power / Heat Plant [3/]	8.767	1.254	8.858	0.398	1.071	0.428	2101004000
Surface Coating (Prime Coat)	0.000	0.048	0.000	0.000	0.000	0.000	2401075000
Surface Coating (Topcoat)	0.000	0.236	0.000	0.000	0.000	0.000	2401075000
Solvent Degreaser	0.000	9.762	0.000	0.000	0.000	0.000	2415000000
Gasoline Tank	0.000	3.004	0.000	0.000	0.000	0.000	2501000120
Subtotal	8.767	14.304	8.858	0.398	1.071	0.428	
Total (3,000 feet mixing height)	12,015.120	613.201	2,649.788	234.947	119.629	46.288	
Total (6,535 feet mixing height)	12,652.482	632.050	4,145.467	332.212	137.652	64.311	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Total PM_{10} for roadways includes entrained road dust.

3/ Includes the central plant. The central plant was not modeled in the EDMS.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table IV-5

2018 McCarran International Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	3,219.686	240.738	2,564.615	225.706	36.976	36.976	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,866.201	260.061	4,242.874	333.290	56.142	56.142	2275000000
Auxiliary Power Unit	112.146	8.433	98.852	13.735	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	3,331.832	249.171	2,663.467	239.441	36.976	36.976	
Subtotal (6,535 feet mixing height)	3,978.347	268.494	4,341.726	347.025	56.142	56.142	
Ground Support Equipment							
Diesel-powered GSE	22.868	4.497	44.299	16.450	11.683	11.334	2270008005
Gasoline-powered GSE	9,632.736	370.789	234.615	17.704	4.565	4.202	2265008005
Subtotal	9,655.604	375.286	278.914	34.154	16.248	15.536	
On-Road Vehicles							
Roadways [2/]	114.399	13.865	7.610	0.220	77.565	0.330	2294005001
Parking Lots	142.281	15.659	7.717	0.086	0.291	0.149	2294005001
Subtotal	256.680	29.524	15.327	0.306	77.856	0.479	
Stationary Sources							
Power / Heat Plant [3/]	8.767	1.254	8.858	0.398	1.071	0.428	2101004000
Surface Coating (Prime Coat)	0.000	0.048	0.000	0.000	0.000	0.000	2401075000
Surface Coating (Topcoat)	0.000	0.236	0.000	0.000	0.000	0.000	2401075000
Solvent Degreaser	0.000	9.762	0.000	0.000	0.000	0.000	2415000000
Gasoline Tank	0.000	3.004	0.000	0.000	0.000	0.000	2501000120
Subtotal	8.767	14.304	8.858	0.398	1.071	0.428	
Total (3,000 feet mixing height)	13,252.883	668.285	2,966.566	274.299	132.151	53.419	
Total (6,535 feet mixing height)	13,899.398	687.608	4,644.825	381.883	151.317	72.585	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.
2/ Total PM_{10} for roadways includes entrained road dust.
3/ Includes the central plant. The central plant was not modeled in the EDMS.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-6

2002 North Las Vegas Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,532.715	34.163	5.804	0.790	11.921	11.921	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,023.520	56.826	10.713	1.373	21.625	21.625	2275000000
Auxiliary Power Unit	0.061	0.004	0.296	0.028	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,532.776	34.167	6.100	0.818	11.921	11.921	
Subtotal (6,535 feet mixing height)	3,023.581	56.830	11.009	1.401	21.625	21.625	
Ground Support Equipment [2/]	27.318	2.283	2.842	0.234	0.053	0.051	2265008005
On-Road Vehicles							
Roadways [3/]	1.170	0.154	0.128	0.001	0.220	0.001	2294005001
Parking Lots	3.889	0.707	0.240	0.007	0.007	0.000	2294005001
Subtotal	5.059	0.861	0.368	0.008	0.227	0.001	
Stationary Sources							
Power / Heat Plant	0.026	0.010	0.117	0.008	0.009	0.009	2101004000
Gasoline Tank	0.000	0.327	0.000	0.000	0.000	0.000	2501000120
Aviation Gasoline	0.000	13.243	0.000	0.000	0.000	0.000	2501080050
Jet A Fuel	0.000	0.032	0.000	0.000	0.000	0.000	2501000150
Subtotal	0.026	13.612	0.117	0.008	0.009	0.009	
Total (3,000 feet mixing height)	1,565.179	50.923	9.427	1.068	12.210	11.982	
Total (6,535 feet mixing height)	3,055.984	73.586	14.336	1.651	21.914	21.686	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at North Las Vegas Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-7

2003 North Las Vegas Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,626.412	36.936	6.668	0.946	12.760	12.760	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,185.540	60.388	12.214	1.629	22.887	22.887	2275000000
Auxiliary Power Unit	0.076	0.005	0.366	0.036	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,626.488	36.941	7.034	0.982	12.760	12.760	
Subtotal (6,535 feet mixing height)	3,185.616	60.393	12.580	1.665	22.887	22.887	
Ground Support Equipment [2/]	29.970	2.500	3.177	0.268	0.056	0.053	2265008005
On-Road Vehicles							
Roadways [3/]	1.129	0.153	0.125	0.001	0.233	0.001	2294005001
Parking Lots	3.850	0.702	0.241	0.007	0.007	0.000	2294005001
Subtotal	4.979	0.855	0.366	0.008	0.240	0.001	
Stationary Sources							
Power / Heat Plant	0.026	0.010	0.117	0.008	0.009	0.009	2101004000
Gasoline Tank	0.000	0.327	0.000	0.000	0.000	0.000	2501000120
Aviation Gasoline	0.000	13.243	0.000	0.000	0.000	0.000	2501080050
Jet A Fuel	0.000	0.032	0.000	0.000	0.000	0.000	2501000150
Subtotal	0.026	13.612	0.117	0.008	0.009	0.009	
Total (3,000 feet mixing height)	1,661.463	53.908	10.694	1.266	13.065	12.823	
Total (6,535 feet mixing height)	3,220.591	77.360	16.240	1.949	23.192	22.950	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at North Las Vegas Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-8

2008 North Las Vegas Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,335.474	31.967	15.718	2.121	12.424	12.424	2275000000
Aircraft [1/] (6,535 feet mixing height)	2,655.694	52.896	27.330	3.497	22.570	22.570	2275000000
Auxiliary Power Unit	0.132	0.010	0.444	0.047	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,335.606	31.977	16.162	2.168	12.424	12.424	
Subtotal (6,535 feet mixing height)	2,655.826	52.906	27.774	3.544	22.570	22.570	
Ground Support Equipment [2/]	211.318	8.616	7.583	0.584	0.208	0.198	2265008005
On-Road Vehicles							
Roadways [3/]	0.624	0.097	0.072	0.000	0.203	0.001	2294005001
Parking Lots	2.387	0.429	0.157	0.000	0.000	0.000	2294005001
Subtotal	3.011	0.526	0.229	0.000	0.203	0.001	
Stationary Sources							
Power / Heat Plant	0.026	0.010	0.117	0.008	0.009	0.009	2101004000
Gasoline Tank	0.000	0.327	0.000	0.000	0.000	0.000	2501000120
Aviation Gasoline	0.000	13.243	0.000	0.000	0.000	0.000	2501080050
Jet A Fuel	0.000	0.032	0.000	0.000	0.000	0.000	2501000150
Subtotal	0.026	13.612	0.117	0.008	0.009	0.009	
Total (3,000 feet mixing height)	1,549.961	54.731	24.091	2.760	12.844	12.632	
Total (6,535 feet mixing height)	2,870.181	75.660	35.703	4.136	22.990	22.778	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at North Las Vegas Airport.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-9

2013 North Las Vegas Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,369.396	32.926	16.583	2.241	12.826	12.826	2275000000
Aircraft [1/] (6,535 feet mixing height)	2,721.322	54.358	28.809	3.694	23.272	23.272	2275000000
Auxiliary Power Unit	0.140	0.013	0.468	0.049	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,369.536	32.939	17.051	2.290	12.826	12.826	
Subtotal (6,535 feet mixing height)	2,721.462	54.371	29.277	3.743	23.272	23.272	
Ground Support Equipment [2/]	223.418	8.754	6.599	0.572	0.373	0.356	2265008005
On-Road Vehicles							
Roadways [3/]	0.460	0.065	0.041	0.000	0.210	0.001	2294005001
Parking Lots	1.416	0.197	0.091	0.000	0.000	0.000	2294005001
Subtotal	1.876	0.262	0.132	0.000	0.210	0.001	
Stationary Sources							
Power / Heat Plant	0.026	0.010	0.117	0.008	0.009	0.009	2101004000
Gasoline Tank	0.000	0.327	0.000	0.000	0.000	0.000	2501000120
Aviation Gasoline	0.000	13.243	0.000	0.000	0.000	0.000	2501080050
Jet A Fuel	0.000	0.032	0.000	0.000	0.000	0.000	2501000150
Subtotal	0.026	13.612	0.117	0.008	0.009	0.009	
Total (3,000 feet mixing height)	1,594.856	55.567	23.899	2.870	13.418	13.192	
Total (6,535 feet mixing height)	2,946.782	76.999	36.125	4.323	23.864	23.638	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at North Las Vegas Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-10

2018 North Las Vegas Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,407.090	34.102	17.526	2.374	13.293	13.293	2275000000
Aircraft [1/] (6,535 feet mixing height)	2,792.483	56.070	30.414	3.908	24.065	24.065	2275000000
Auxiliary Power Unit	0.148	0.013	0.498	0.054	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,407.238	34.115	18.024	2.428	13.293	13.293	
Subtotal (6,535 feet mixing height)	2,792.631	56.083	30.912	3.962	24.065	24.065	
Ground Support Equipment [2/]	237.005	9.036	6.256	0.579	0.476	0.455	2265008005
On-Road Vehicles							
Roadways [3/]	0.396	0.049	0.025	0.000	0.221	0.001	2294005001
Parking Lots	1.297	0.163	0.060	0.000	0.000	0.000	2294005001
Subtotal	1.693	0.212	0.085	0.000	0.001	0.221	
Stationary Sources							
Power / Heat Plant	0.026	0.010	0.117	0.008	0.009	0.009	2101004000
Gasoline Tank	0.000	0.327	0.000	0.000	0.000	0.000	2501000120
Aviation Gasoline	0.000	13.243	0.000	0.000	0.000	0.000	2501080050
Jet A Fuel	0.000	0.032	0.000	0.000	0.000	0.000	2501000150
Subtotal	0.026	13.612	0.117	0.008	0.009	0.009	
Total (3,000 feet mixing height)	1,645.962	56.975	24.482	3.015	13.999	13.758	
Total (6,535 feet mixing height)	3,031.355	78.943	37.370	4.549	24.771	24.530	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} and $PM_{2.5}$ emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at North Las Vegas Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-11

2002 Henderson Executive Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	479.952	15.899	3.659	0.460	4.312	4.312	2275000000
Aircraft [1/] (6,535 feet mixing height)	970.371	24.186	6.568	0.775	7.928	7.928	2275000000
Auxiliary Power Unit	0.061	0.004	0.296	0.028	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	480.013	15.903	3.955	0.488	4.312	4.312	
Subtotal (6,535 feet mixing height)	970.432	24.190	6.864	0.803	7.928	7.928	
Ground Support Equipment [2/]	27.318	2.283	2.842	0.234	0.053	0.051	2265008005
On-Road Vehicles							
Roadways [3/]	1.093	0.140	0.119	0.003	0.210	0.002	2294005001
Parking Lots	0.817	0.137	0.055	0.001	0.001	0.001	2294005001
Subtotal	1.910	0.277	0.174	0.004	0.211	0.003	
Stationary Sources							
Jet A Fuel	0.000	0.019	0.000	0.000	0.000	0.000	2501000150
Aviation Gasoline	0.000	1.509	0.000	0.000	0.000	0.000	2501080050
Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	2501000120
Subtotal	0.000	1.571	0.000	0.000	0.000	0.000	
Total (3,000 feet mixing height)	509.241	20.034	6.971	0.726	4.576	4.366	
Total (6,535 feet mixing height)	999.660	28.321	9.880	1.041	8.192	7.982	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Henderson Executive Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-12

2003 Henderson Executive Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	874.178	13.425	1.779	0.192	4.043	4.043	2275000000
Aircraft [1/] (6,535 feet mixing height)	1,740.404	22.840	3.301	0.342	7.268	7.268	2275000000
Auxiliary Power Unit	0.380	0.023	0.101	0.023	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	874.558	13.448	1.880	0.215	4.043	4.043	
Subtotal (6,535 feet mixing height)	1,740.784	22.863	3.402	0.365	7.268	7.268	
Ground Support Equipment [2/]	43.031	2.197	1.927	0.096	0.025	0.024	2265008005
On-Road Vehicles							
Roadways [3/]	0.953	0.123	0.105	0.002	0.202	0.002	2294005001
Parking Lots	0.733	0.123	0.051	0.001	0.001	0.001	2294005001
Subtotal	1.686	0.246	0.156	0.003	0.203	0.003	
Stationary Sources							
Jet A Fuel	0.000	0.019	0.000	0.000	0.000	0.000	2501000150
Aviation Gasoline	0.000	1.509	0.000	0.000	0.000	0.000	2501080050
Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	2501000120
Subtotal	0.000	1.571	0.000	0.000	0.000	0.000	
Total (3,000 feet mixing height)	919.275	17.462	3.963	0.314	4.271	4.070	
Total (6,535 feet mixing height)	1,785.501	26.877	5.485	0.464	7.496	7.295	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Henderson Executive Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-13

2008 Henderson Executive Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,243.384	19.013	2.496	0.269	5.731	5.731	2275000000
Aircraft [1/] (6,535 feet mixing height)	2,477.214	32.415	4.642	0.481	10.312	10.312	2275000000
Auxiliary Power Unit	0.536	0.031	0.143	0.031	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,243.920	19.044	2.639	0.300	5.731	5.731	
Subtotal (6,535 feet mixing height)	2,477.750	32.446	4.785	0.512	10.312	10.312	
Ground Support Equipment [2/]	59.471	2.828	2.226	0.137	0.034	0.030	2265008005
On-Road Vehicles							
Roadways [3/]	0.752	0.114	0.086	0.001	0.282	0.002	2294005001
Parking Lots	0.655	0.108	0.046	0.000	0.001	0.000	2294005001
Subtotal	1.407	0.222	0.132	0.001	0.283	0.002	
Stationary Sources							
Jet A Fuel	0.000	0.019	0.000	0.000	0.000	0.000	2501000150
Aviation Gasoline	0.000	1.509	0.000	0.000	0.000	0.000	2501080050
Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	2501000120
Subtotal	0.000	1.571	0.000	0.000	0.000	0.000	
Total (3,000 feet mixing height)	1,304.798	23.665	4.997	0.438	6.048	5.763	
Total (6,535 feet mixing height)	2,538.628	37.067	7.143	0.650	10.629	10.344	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Henderson Executive Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc..
Prepared by: Ricondo & Associates, Inc.

Table IV-14

2013 Henderson Executive Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	1,551.143	24.063	3.600	0.396	7.490	7.490	2275000000
Aircraft [1/] (6,535 feet mixing height)	3,093.674	40.978	6.788	0.715	13.552	13.552	2275000000
Auxiliary Power Unit	0.623	0.037	0.165	0.035	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	1,551.766	24.100	3.765	0.431	7.490	7.490	
Subtotal (6,535 feet mixing height)	3,094.297	41.015	6.953	0.750	13.552	13.552	
Ground Support Equipment [2/]	72.511	3.184	2.202	0.184	0.042	0.040	2265008005
On-Road Vehicles							
Roadways [3/]	0.709	0.094	0.064	0.001	0.333	0.002	2294005001
Parking Lots	0.506	0.064	0.036	0.000	0.002	0.000	2294005001
Subtotal	1.215	0.158	0.100	0.001	0.335	0.002	
Stationary Sources							
Jet A Fuel	0.000	0.019	0.000	0.000	0.000	0.000	2501000150
Aviation Gasoline	0.000	1.509	0.000	0.000	0.000	0.000	2501080050
Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	2501000120
Subtotal	0.000	1.571	0.000	0.000	0.000	0.000	
Total (3,000 feet mixing height)	1,625.492	29.013	6.067	0.616	7.867	7.532	
Total (6,535 feet mixing height)	3,168.023	45.928	9.255	0.935	13.929	13.594	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Henderson Executive Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-15

2018 Henderson Executive Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	3,869.460	51.093	8.498	0.894	16.852	16.852	2275000000
Aircraft [1/] (6,535 feet mixing height)	1,937.566	29.916	4.512	0.494	9.294	9.294	2275000000
Auxiliary Power Unit	0.733	0.043	0.194	0.042	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	3,870.193	51.136	8.692	0.936	16.852	16.852	
Subtotal (6,535 feet mixing height)	1,938.299	29.959	4.706	0.536	9.294	9.294	
Ground Support Equipment [2/]	88.573	3.561	2.059	0.221	0.053	0.048	2265008005
On-Road Vehicles							
Roadways [3/]	0.721	0.085	0.047	0.001	0.414	0.002	2294005001
Parking Lots	0.547	0.062	0.028	0.000	0.000	0.000	2294005001
Subtotal	1.268	0.147	0.075	0.001	0.414	0.002	
Stationary Sources							
Jet A Fuel	0.000	0.019	0.000	0.000	0.000	0.000	2501000150
Aviation Gasoline	0.000	1.509	0.000	0.000	0.000	0.000	2501080050
Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	2501000120
Subtotal	0.000	1.571	0.000	0.000	0.000	0.000	
Total (3,000 feet mixing height)	3,960.034	56.415	10.826	1.158	17.319	16.902	
Total (6,535 feet mixing height)	2,028.140	35.238	6.840	0.758	9.761	9.344	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Henderson Executive Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-16

2002 Jean Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	2275000000
Aircraft [1/] (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	
Subtotal (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	
Ground Support Equipment [2/]	18.125	0.855	0.714	0.034	0.008	0.008	2265008005
On-Road Vehicles							
Roadways [3/]	0.865	0.114	0.095	0.000	0.165	0.000	2294005001
Parking Lots	0.287	0.045	0.022	0.001	0.001	0.000	2294005001
Subtotal	1.152	0.159	0.117	0.001	0.166	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	303.562	5.471	0.979	0.058	1.303	1.137	
Total (6,535 feet mixing height)	577.325	8.384	1.125	0.080	2.150	1.984	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Jean Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc

Table IV-17

2003 Jean Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	2275000000
Aircraft [1/] (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	
Subtotal (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	
Ground Support Equipment [2/]	18.038	0.853	0.711	0.034	0.008	0.008	2265008005
On-Road Vehicles							
Roadways [3/]	0.786	0.101	0.085	0.000	0.164	0.000	2294005001
Parking Lots	0.268	0.042	0.021	0.001	0.000	0.000	2294005001
Subtotal	1.054	0.143	0.106	0.001	0.164	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	303.377	5.453	0.965	0.058	1.301	1.137	
Total (6,535 feet mixing height)	577.140	8.366	1.111	0.080	2.148	1.984	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Jean Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-18

2008 Jean Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	2275000000
Aircraft [1/] (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	
Subtotal (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	
Ground Support Equipment [2/]	17.822	0.791	0.607	0.035	0.008	0.008	2265008005
On-Road Vehicles							
Roadways [3/]	0.440	0.066	0.051	0.000	0.145	0.000	2294005001
Parking Lots	0.171	0.025	0.013	0.000	0.000	0.000	2294005001
Subtotal	0.611	0.091	0.064	0.000	0.145	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	302.718	5.339	0.819	0.058	1.282	1.137	
Total (6,535 feet mixing height)	576.481	8.252	0.965	0.080	2.129	1.984	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Jean Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-19

2013 Jean Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	2275000000
Aircraft [1/] (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	
Subtotal (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	
Ground Support Equipment [2/]	17.752	0.728	0.487	0.036	0.008	0.008	2265008005
On-Road Vehicles							
Roadways [3/]	0.312	0.042	0.026	0.000	0.145	0.000	2294005001
Parking Lots	0.098	0.012	0.008	0.000	0.000	0.000	2294005001
Subtotal	0.410	0.054	0.034	0.000	0.145	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	302.447	5.239	0.669	0.059	1.282	1.137	
Total (6,535 feet mixing height)	576.210	8.152	0.815	0.081	2.129	1.984	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Jean Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-20

2018 Jean Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	2275000000
Aircraft [1/] (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	284.285	4.431	0.148	0.023	1.129	1.129	
Subtotal (6,535 feet mixing height)	558.048	7.344	0.294	0.045	1.976	1.976	
Ground Support Equipment [2/]	17.741	0.684	0.401	0.036	0.008	0.008	2265008005
On-Road Vehicles							
Roadways [3/]	0.254	0.030	0.017	0.000	0.145	0.000	2294005001
Parking Lots	0.086	0.009	0.004	0.000	0.000	0.000	2294005001
Subtotal	0.340	0.039	0.021	0.000	0.145	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	302.366	5.180	0.570	0.059	1.282	1.137	
Total (6,535 feet mixing height)	576.129	8.093	0.716	0.081	2.129	1.984	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Jean Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc..
Prepared by: Ricondo & Associates, Inc.

Table IV-21

2002 Perkins Field Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	77.119	1.316	0.04	0.007	0.324	0.324	2275000000
Aircraft [1/] (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	
Subtotal (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	
Ground Support Equipment [2/]	7.390	0.208	0.491	0.004	0.002	0.002	2265008005
On-Road Vehicles							
Roadways [3/]	0.292	0.039	0.033	0.000	0.055	0.000	2294005001
Parking Lots	0.073	0.011	0.006	0.000	0.000	0.000	2294005001
Subtotal	0.365	0.050	0.039	0.000	0.055	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.007	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	84.874	1.581	0.570	0.011	0.381	0.326	
Total (6,535 feet mixing height)	156.042	2.338	0.607	0.016	0.602	0.547	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Perkins Field Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-22

2003 Perkins Field Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	2275000000
Aircraft [1/] (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	
Subtotal (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	
Ground Support Equipment [2/]	7.390	0.208	0.491	0.004	0.002	0.002	2265008005
On-Road Vehicles							
Roadways [3/]	0.267	0.034	0.029	0.000	0.055	0.000	2294005001
Parking Lots	0.068	0.011	0.006	0.000	0.000	0.000	2294005001
Subtotal	0.335	0.045	0.035	0.000	0.055	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.007	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	84.844	1.576	0.566	0.011	0.381	0.326	
Total (6,535 feet mixing height)	156.012	2.333	0.603	0.016	0.602	0.547	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Perkins Field Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table IV-23

2008 Perkins Field Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	2275000000
Aircraft [1/] (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	
Subtotal (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	
Ground Support Equipment [2/]	7.390	0.208	0.491	0.004	0.002	0.002	2265008005
On-Road Vehicles							
Roadways [3/]	0.148	0.022	0.017	0.000	0.049	0.000	2294005001
Parking Lots	0.043	0.007	0.003	0.000	0.000	0.000	2294005001
Subtotal	0.191	0.029	0.020	0.000	0.049	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.014	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	84.700	1.567	0.551	0.011	0.375	0.326	
Total (6,535 feet mixing height)	155.868	2.324	0.588	0.016	0.596	0.547	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Perkins Field Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc

Table IV-24

2013 Perkins Field Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	2275000000
Aircraft [1/] (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	
Subtotal (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	
Ground Support Equipment [2/]	7.390	0.208	0.491	0.004	0.002	0.002	2265008005
On-Road Vehicles							
Roadways [3/]	0.105	0.013	0.009	0.000	0.049	0.000	2294005001
Parking Lots	0.025	0.003	0.002	0.000	0.000	0.000	2294005001
Subtotal	0.130	0.016	0.011	0.000	0.049	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.014	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	84.639	1.554	0.542	0.011	0.375	0.326	
Total (6,535 feet mixing height)	155.807	2.311	0.579	0.016	0.596	0.547	

Notes:
SCC = Source Classification Code
1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Perkins Field Airport.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table IV-25

2018 Perkins Field Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	2275000000
Aircraft [1/] (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	77.119	1.316	0.040	0.007	0.324	0.324	
Subtotal (6,535 feet mixing height)	148.287	2.073	0.077	0.012	0.545	0.545	
Ground Support Equipment [2/]	7.390	0.208	0.491	0.004	0.002	0.002	2265008005
On-Road Vehicles							
Roadways [3/]	0.086	0.009	0.007	0.000	0.049	0.000	2294005001
Parking Lots	0.022	0.002	0.001	0.000	0.000	0.000	2294005001
Subtotal	0.108	0.011	0.008	0.000	0.049	0.000	
Stationary Sources							
Aviation Gasoline	0.000	0.014	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	84.617	1.549	0.539	0.011	0.375	0.326	
Total (6,535 feet mixing height)	155.785	2.306	0.576	0.016	0.596	0.547	

Notes:

SCC = Source Classification Code

1/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

2/ Gasoline- and diesel-powered ground support equipment are not differentiated in the EDMS output when using the LTO-based modeling approach. The listed SCC represents gasoline-powered ground support equipment, which is the predominant type of ground support equipment in use at Perkins Field Airport.

3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table IV-26

2013 South of Sloan Regional Heliport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	22.179	3.483	3.140	0.379	2.740	2.740	2275000000
Aircraft [1/] (6,535 feet mixing height)	35.068	4.678	6.504	0.745	5.158	5.158	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	22.179	3.483	3.140	0.379	2.740	2.740	
Subtotal (6,535 feet mixing height)	35.068	4.678	6.504	0.745	5.158	5.158	
Ground Support Equipment [2/]	1.262	0.334	4.096	1.182	0.572	0.554	2270008005
On-Road Vehicles							
Roadways [3/]	0.388	0.051	0.035	0.000	0.207	0.000	2294005001
Parking Lots	0.195	0.030	0.012	0.000	0.000	0.000	2294005001
Subtotal	0.583	0.081	0.047	0.000	0.207	0.000	
Stationary Sources							
Jet Kerosene	0.000	0.004	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	24.024	3.902	7.283	1.561	3.519	3.294	
Total (6,535 feet mixing height)	36.913	5.097	10.647	1.927	5.937	5.712	

Notes:
SCC = Source Classification Code
1/ The helicopter PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Default ground support equipment in EDMS version 4.3 for the Bell 206 helicopter is diesel-fueled.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc., based on information in the *Environmental Assessment for a Southern Nevada Regional Heliport*, January 2006.
Prepared by: Ricondo & Associates, Inc.

Table IV-27

2018 South of Sloan Regional Heliport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/] (3,000 feet mixing height)	26.975	4.237	3.820	0.462	3.333	3.333	2275000000
Aircraft [1/] (6,535 feet mixing height)	42.653	5.690	7.910	0.906	6.273	6.273	2275000000
Auxiliary Power Unit	0.000	0.000	0.000	0.000	0.000	0.000	2275070000
Subtotal (3,000 feet mixing height)	26.975	4.237	3.820	0.462	3.333	3.333	
Subtotal (6,535 feet mixing height)	42.653	5.690	7.910	0.906	6.273	6.273	
Ground Support Equipment [2/]	1.262	0.334	4.096	1.182	0.572	0.554	2270008005
On-Road Vehicles							
Roadways [3/]	0.388	0.051	0.035	0.000	0.207	0.000	2294005001
Parking Lots	0.195	0.030	0.012	0.000	0.000	0.000	2294005001
Subtotal	0.583	0.081	0.047	0.000	0.207	0.000	
Stationary Sources							
Jet Kerosene	0.000	0.004	0.000	0.000	0.000	0.000	2501080050
Total (3,000 feet mixing height)	28.820	4.656	7.963	1.644	4.112	3.887	
Total (6,535 feet mixing height)	44.498	6.109	12.053	2.088	7.052	6.827	

Notes:
SCC = Source Classification Code
1/ The helicopter PM_{10} emissions methodology and calculations are described in Appendix A.
2/ Default ground support equipment in EDMS version 4.3 for the Bell 206 helicopter is diesel-fueled.
3/ Total PM_{10} for roadways includes entrained road dust.

Source: Ricondo & Associates, Inc., based on information in the *Environmental Assessment for a Southern Nevada Regional Heliport*, January 2006.
Prepared by: Ricondo & Associates, Inc.

Table IV-28

2018 Ivanpah Airport Emissions Inventory – Tons per Year

Source	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	SCC
Aircraft-Related							
Aircraft [1/, 2/]	2,121.329	162.131	3,850.739	270.833	29.053	29.053	2275000000
Auxiliary Power Unit	86.701	5.995	70.831	9.164	0.000	0.000	2275070000
Subtotal	2,121.329	162.131	3,850.739	270.833	29.053	29.053	
Ground Support Equipment	7,031.263	254.197	207.92	27.565	24.020	23.217	2265008005
On-Road Vehicles							
Roadways	316.093	17.760	9.518	0.370	11.953	0.614	2294005001
Parking Lots	33.672	3.870	2.065	0.000	0.129	0.000	2294005001
Subtotal	349.765	21.630	11.583	0.370	12.082	0.614	
Stationary Sources							
Boiler	33.762	2.212	20.092	0.238	3.056	3.056	2101004000
Emergency Generator	4.557	0.637	10.303	0.331	0.578	0.578	2101004000
Subtotal	38.319	2.849	30.395	0.569	3.634	3.634	
Total	9,627.377	446.802	4,171.468	308.501	68.789	56.518	

Notes:

SCC = Source Classification Code

1/ Aircraft-related emissions were modeled at a mixing height of 7,875 feet to be consistent with the analysis conducted by MWH Americas, Inc.

2/ The aircraft PM_{10} emissions methodology and calculations are described in Appendix A.

Source: Ricondo & Associates, Inc., based on information in MWH Americas, Inc., *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.

Prepared by: Ricondo & Associates, Inc.

V. Construction Emissions

Tables V-1 through **V-4** provide descriptions of construction projects at the airports currently managed by the Department of Aviation that have just been completed, are nearing completion, or are anticipated to be completed in the near future. Construction emission estimates for these projects are not included in this report because most of the projects would not generate significant construction-related emissions or have already been constructed.

Emissions estimated to be associated with construction of the Heliport are presented in **Table V-5**. These emissions estimates were taken directly from the *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport*. **Table V-6** presents peak-year construction emissions estimated to be associated with construction of the Ivanpah Airport, which were taken directly from the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*. The Department of Aviation respectfully requests that DAQEM include these emissions estimates in the 8-hour ozone SIP for Clark County, as applicable.

Planning for the proposed heliport and Ivanpah Airport are still on-going. The forecasts and emissions inventories presented in this report are preliminary and have been designed to be conservative for air quality planning purposes. Actual forecasts and emissions may differ in the future based on more detailed planning and analysis.

Table V-1

Summary of Ongoing Projects at McCarran International Airport

Project Name	Description	Status
Northwest Extension of Concourse D	Extension of Concourse D northwest from the rotunda to replace six gates that were removed from service on Concourses A and B in Terminal 1 to accommodate facilities required by the Transportation Security Administration.	Environmental review process completed with construction scheduled to begin in 2005.
Ramp and Taxiway / Runway Complex Reconstruction	Required maintenance for facilities to remain in service. Substantial replacement of existing asphalt pavement on Runway 7L-25R.	Construction to begin in 2005 and continue through 2007. Reconstruction of Runway 7L-25R pavement scheduled to begin in 2008.
Security Fence Upgrade	Upgrade of security fencing around the Air Operations Area.	Construction to begin during summer 2005.
Northwest Area Hangar and Remain Overnight (RON) Aircraft Parking Development	Construct three main hangar facilities on undeveloped areas on the northwest side of the airport to accommodate general aviation aircraft currently parked on ramps. The RON aircraft parking apron would serve aircraft from Terminals 1 and 2, excluding Concourse D.	Construction of hangars and RON aircraft parking estimated to be completed early in 2006 and 2007, respectively.
Concourse B/C Connector and Security Annex	Expand security checkpoint facilities, including 12 new security processing checkpoints to serve Concourses A, B, and C (referred to as the security annex). A replacement gate and concession facilities, and a pedestrian connector from Concourse B to Concourse C, would reduce queuing and wait times for passengers passing through Concourse C security screening and allow Southwest Airlines' passengers to access gates on Concourse B without having to exit the secure area on Concourse C.	Construction to start in 2005.
Terminal 3	Provide 15 additional aircraft gates, ticketing counters, baggage claim facilities, parking garages, and a separate roadway system. The terminal will be connected to Concourse D and will serve both international and domestic airlines.	Construction of Terminal 3, beginning with the Russell Road relocation, is estimated to start in 2006.

Sources: Ricondo & Associates, Inc., *Airport Capital Improvement Program (ACIP)* for *2004-2009*, 2004 **[V-1]**; and *Airport Capital Improvement Program (ACIP) for 2006-2010*, 2005 **[V-2]**.

Prepared by: Ricondo & Associates, Inc.

Table V-2

Summary of Recently Completed and Ongoing Projects at North Las Vegas Airport

Project Name	Description	Status
Eastside Basing Area	Final construction of the Eastside Basing Area, which includes ramps, access road, fencing, drainage improvements, tiedowns, fueling facilities, and specialty based operations.	Construction is estimated to be completed in 2006.
Runway 12L-30R Extension	Extension of runway by 200 feet to accommodate installation of an Instrument Landing System on Runway 12L.	Construction was completed in 2004.
Blimp Landing and Staging Area	Project will provide facilities for blimp landing and staging area that will include access road and vehicle parking area.	Construction to be completed in 2005.
Taxilane / Apron Pavement Rehabilitation	Rehabilitation of apron and taxilanes around the airport.	Construction estimated to occur between 2007 and 2009.
Drainage Improvements	Construction to cover existing exposed drainage channels at the airport to prevent safety hazard to aircraft operations.	Construction estimated to occur between 2005 and 2007.

Sources: Ricondo & Associates, Inc., *Airport Capital Improvement Program (ACIP) for 2004-2009*, 2004; and *Airport Capital Improvement Program (ACIP) for 2006-2010*, 2005.

Prepared by: Ricondo & Associates, Inc.

Table V-3

Summary of Recently Completed and Ongoing Projects at Henderson Executive Airport

Project Name	Description	Status
Construction of Shade Hangars	Construction of two new shade hangars, with 37 parking positions.	Completed in 2004.
Construction of Executive Hangars	Construction of 95 enclosed hangars.	Completed in 2005.
Terminal Apron Expansion Construction	Construction of apron to serve new general aviation terminal building for aircraft parking.	Completed in 2005.
Construction of New General/Corporate Aviation Terminal	Construction of 22,000 square foot general aviation/corporate terminal with a stand-alone Airport Traffic Control Tower.	Anticipated to be completed by 2006.
North Apron and Access Roadway Construction	Expansion of apron area north of new terminal building for based aircraft parking and transient aircraft operations.	Construction anticipated to be completed by 2006.
Construction of a North Apron-Edge Taxilane	Construction of a north apron-edge taxilane and aircraft run-up area, consisting of approximately 150,000 square feet of asphalt pavement, including grading, drainage, lighting, marking, and signage.	Construction anticipated to be completed by 2007.
Aircraft Rescue and Fire Fighting Station	Construction of aircraft rescue and fire fighting station at the airport to meet prescribed index for Category B-III airport.	Construction anticipated to be completed by 2008.
South Development Area Construction	Construction of taxilanes, access roadway, and utility infrastructure for South Development Area. The area will be designated for based aircraft parking, commercial hangars, and private aircraft storage hangars.	Construction anticipated to be completed by 2009.

Sources: Ricondo & Associates, Inc., *Airport Capital Improvement Program (ACIP) for 2004-2009*, 2004; and *Airport Capital Improvement Program (ACIP) for 2006-2010*, 2005.

Prepared by: Ricondo & Associates, Inc.

Table V-4

Summary of Ongoing Projects at Perkins Field Airport

Project Name	Description	Status
East Development Area	Construction of roadways, taxilanes, and related infrastructure required to facilitate commercial aviation development on the east side of the airfield.	Construction anticipated to be completed in 2008.
Asphalt Pavement Rehabilitation	Slurry coat (fog seal) on airport pavement as identified in Pavement Maintenance Management Program.	Construction anticipated to be completed in 2006.

Sources: Ricondo & Associates, Inc., *Airport Capital Improvement Program (ACIP) for 2004-2009*, 2004; and *Airport Capital Improvement Program (ACIP) for 2006-2010*, 2005.
Prepared by: Ricondo & Associates, Inc.

Table V-5

Estimated Construction Emissions, South of Sloan Regional Heliport

	Pollutant Emissions (tons/year)									
	2007					2008				
Source	CO	VOC	NO_X	SO_X	PM_{10}	CO	VOC	NO_X	SO_X	PM_{10}
On-Road/On-Site Equipment	0.030	0.008	0.003	0.000	0.000	0.139	0.039	0.014	0.000	0.000
On-Road/Off-Site Equipment [1/]	0.371	0.040	0.038	0.000	0.102	3.420	0.367	0.344	0.004	1.032
Nonroad Equipment	0.429	0.085	1.654	0.151	0.068	2.715	0.556	9.917	0.308	0.426
Land Development	-	-	-	-	0.000	-	-	-	-	35.144
Wind Erosion	-	-	-	-	0.000	-	-	-	-	4.644
Asphalt Paving	-	0.000	-	-	-	-	47.951	-	-	-
Total [2/]	0.830	0.133	1.696	0.151	0.170	6.274	48.913	10.276	0.312	41.246

Source: Ricondo & Associates, Inc., *Administrative Draft Environmental Assessment for a Southern Nevada Regional Heliport*. January 2006.
Prepared by: Ricondo & Associates, Inc.

Table V-6

Estimated Peak-Year Construction Emissions, Proposed Ivanpah Airport

	2013 Pollutant Emissions (tons/year)				
Source	CO	VOC	NO_X	SO_X	PM_{10}
BLM Pit	13.59	4.33	49.82	4.57	91.93
Pit and Paved Roads	0.50	0.07	1.57	0.05	12.93
On-Airport Equipment	8.78	2.55	27.50	3.10	36.72
Airport Haul Road	0.08	0.01	0.26	0.01	12.79
Total	22.95	6.97	79.16	7.73	154.37

Source: Ricondo & Associates, Inc., based on information in MWH Americas, Inc., *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.
Prepared by: Ricondo & Associates, Inc.

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Appendix A Aircraft PM_{10} and $PM_{2.5}$ Calculations

Historically, the Emissions and Dispersion Modeling System (EDMS) could not be used to calculate particulate[1] emissions resulting from aircraft operations. However, EDMS version 4.3, released in August 2005, is able to calculate particulate emissions for some aircraft engines through incorporation of the Federal Aviation Administration's (FAA's) first-order approximation (FOA), version 2.0, methodology. To calculate particulate emissions for aircraft engines for which the FOA methodology does not apply, an alternative methodology based on particulate emissions data contained in AP-42, *Compilation of Air Pollutant Emission Factors*, Volume IV: "Mobile Sources", may be used. The purpose of this appendix is to explain how a combination of these two methodologies can be used to derive aircraft-related particulate emissions for all aircraft/engine types analyzed in the Clark County Airport System emissions inventory.

The two methodologies used for calculating aircraft-related particulate emissions–the FOA methodology and the AP-42 methodology–are described below. The process used to integrate the particulate emissions derived using the AP-42 methodology into EDMS is also described.

A.1 Methodologies for Calculating Aircraft Particulate Emissions

A.1.1 First-Order Approximation Methodology

On May 24, 2005, the FAA issued guidance regarding the estimation of aircraft-related PM_{10} and $PM_{2.5}$ emissions. As discussed on the EDMS website, the FAA's FOA methodology is used to estimate particulate emissions from commercial jet-turbine aircraft engines. The FOA serves an interim purpose of meeting particulate compliance issues now, while the science and accuracy of particulate measurement techniques evolve. The nonvolatile portion of particulate matter is based on a correlation between a smoke number (SN) from the engine certification test and the fuel flowage rate for a specific mode of operation, namely takeoff, climbout, taxi/idle, and approach. These data are available from the International Civil Aviation Organization (ICAO).[2]

The FOA methodology has been incorporated into the algorithms used in EDMS version 4.3. EDMS uses the FOA methodology to derive particulate emission indices by mode for applicable aircraft engine types and then calculates aircraft-related particulate emissions. One limitation of the FOA method is that it is only applicable to aircraft engines for which SNs and modal fuel flows have been reported. As a result, the FOA method is not applicable to most piston, turboprop, and military aircraft engines. **Table A-1** lists the engine types applicable to this emissions inventory for which EDMS is able to calculate aircraft-related particulate emissions based on the availability of SN and modal fuel flow data. The table also shows the corresponding ICAO Aircraft Engine Emissions Databank identification number, as well as the particulate emission indices, by mode, for each engine type as calculated by EDMS.

[1] Particulate emissions refer to both PM_{10} and $PM_{2.5}$. For aircraft, it is assumed in EDMS that $PM_{2.5}$ emissions are equal to PM_{10} emissions.

[2] ICAO has published the most complete aircraft engine emission database, which includes the measured smoke number and fuel flow rates by engine mode. The ICAO Aircraft Engine Emissions Databank contains information on exhaust emissions only for those aircraft engines that have entered production. The information in the databank is provided by the engine manufacturers, who are solely responsible for its accuracy. The databank is updated periodically. The databank was last updated on June 6, 2005 (Issue 14). The electronic version of the databank is available at http://www.caa.co.uk/default.aspx?categoryid=702&pagetype=90

Table A-1

Applicable Engine Types for First-Order Approximation Methodology

ICAO ID	EDMS Engine Type	Particulate Emission Indices by Mode (g/kg) [1/]			
		Takeoff	Climbout	Approach	Taxi/Idle
4AL003	AE3007A	0.002400	0.002400	0.002400	0.002400
4BR004	BR700-715C1-30	0.028840	0.018287	0.002803	0.001868
1GE035	CF34-3A1	0.620884	0.130325	0.018393	0.018393
6GE093	CF34-8E2	0.037134	0.002230	0.037134	0.037134
3GE070	CF6-50C	0.192011	0.204920	0.005656	0.004398
3GE074	CF6-50C2	0.178302	0.201503	0.005719	0.004398
1GE012	CF6-80A2	0.210251	0.151430	0.008357	0.008357
2GE055	CF6-80C2B7F	0.077650	0.048296	0.077650	0.077650
1CM003	CFM56-2C5	0.060379	0.017339	0.013402	0.009921
1CM004	CFM56-3-B1	0.029102	0.012488	0.012488	0.009921
1CM005	CFM56-3B-2	0.060379	0.017339	0.012488	0.009921
1CM007	CFM56-3C-1	0.094601	0.027805	0.012488	0.010748
4CM036	CFM56-5A5	0.288281	0.288281	0.288281	0.288281
2CM014	CFM56-5B4	0.151430	0.200884	0.200884	0.200884
3CM028	CFM56-5B6/P	0.049948	0.049948	0.049948	0.049948
3CM031	CFM56-7B22	0.210251	0.210251	0.210251	0.210251
3CM032	CFM56-7B24	0.229550	0.229550	0.229550	0.229550
3CM033	CFM56-7B26	0.302958	0.302958	0.302958	0.302958
1PW002	JT3D-7 Series	2.944539	0.436216	2.944539	0.436216
1PW010	JT8D-15	0.341060	0.341060	0.341060	0.341060
1PW013	JT8D-17	0.385272	0.385272	0.385272	0.385272
4PW068	JT8D-217	0.062202	0.062202	0.062202	0.062202
4PW069	JT8D-217A	0.062202	0.062202	0.062202	0.062202
4PW070	JT8D-217C	0.062202	0.062202	0.062202	0.062202
4PW071	JT8D-219	0.077650	0.077650	0.077650	0.077650
1PW007	JT8D-9	0.154166	0.154166	0.154166	0.154166
1PW007	JT8D-9A	0.154166	0.154166	0.154166	0.154166
1PW025	JT9D-7Q	0.101338	0.101338	0.101338	0.101338
4PW072	PW2037	0.165330	0.165330	0.165330	0.165330
4PW073	PW2040	0.171042	0.171042	0.171042	0.171042
1PW042	PW4056	0.096824	0.096824	0.096824	0.096824
1PW043	PW4060	0.108281	0.108281	0.108281	0.108281
5PW076	PW4098	0.133659	0.133659	0.133659	0.133659
1RR003	RB211-22B	0.657062	0.657062	0.657062	0.657062
1RR012	RB211-535C	0.101338	0.101338	0.101338	0.101338
3RR028	RB211-535E4	0.006914	0.006914	0.006914	0.006914
5RR039	RB211-535E4B	0.085939	0.085939	0.085939	0.085939
1RR019	TAY Mk611-8	0.590601	0.590601	0.590601	0.590601
2RR027	TRENT-890	0.048954	0.048954	0.048954	0.048954
1IA001	V2500-A1	0.022884	0.022884	0.022884	0.022884
3IA006	V2522-A5	0.125270	0.125270	0.125270	0.125270
3IA007	V2524-A5	0.125270	0.125270	0.125270	0.125270
1IA002	V2525-D5	0.125270	0.125270	0.125270	0.125270
1IA003	V2527-A5	0.125270	0.125270	0.125270	0.125270

Note:

1/ Particulate emission indices are identical for both PM_{10} and $PM_{2.5}$.

Source: Federal Aviation Administration, Emissions and Dispersion Modeling System (EDMS), Version 4.3.

Prepared by: Ricondo & Associates, Inc.

A.1.2 AP-42 Methodology

In cases where EDMS version 4.3 cannot be used to calculate aircraft-related particulate emissions using the FOA, an alternative methodology is required. The U.S. Environmental Protection Agency (EPA) has developed guidance for calculating aircraft-related PM_{10} emissions. The methodology and assumptions used to calculate aircraft-related particulate emissions for engine types that cannot be calculated in EDMS using the FOA are described below.

A.1.2.1 Air Pollutant Emission Factors in AP-42

The primary source of information on aircraft PM_{10} emissions is the U.S. EPA document, AP-42,[3] which contains detailed information regarding fuel flowage rates and emission factors for CO, NO_X, SO_X, HC, and PM_{10} from the operation of nine types of commercial aircraft engines and eight types of military aircraft engines. **Table A-2** lists the particulate emission factors for the different engine types applicable to the Clark County Airport System emissions inventory. The emission factors are provided for the four modes of a landing and takeoff (LTO) cycle.

Table A-2

PM_{10} Emission Factors by Aircraft Engine Type and Mode

			PM_{10} Emission Factors by Mode (kg/hr)			
Engine Type	Propulsion	Representative Aircraft Type	Approach	Climbout	Takeoff	Taxi/Idle
CF6-50C	Jet	Commercial	0.20	0.24	0.24	0.02
F100-PW-100	Jet	Military Fighter/Trainer	0.50	3.90	0.00	0.05
SPEY MK511	Jet	Small/Business Jet	0.68	4.50	7.30	0.08
TPE331-3	Prop/Turboprop	Single-/Multi-engine Prop	0.27	0.27	0.36	0.14

Source: U.S. Environmental Protection Agency, *AP-42, Compilation of Air Pollutant Emission Factors,* Volume IV: "Mobile Sources", Fourth Edition, 1992.
Prepared by: Ricondo & Associates, Inc.

A.1.2.2 Aircraft Engine Substitution Matrix

Because a comprehensive list of particulate emission factors for civilian aircraft engines is not available, a variety of engine substitution assumptions were required to model particulate emissions for engine types that could not be calculated in EDMS using the FOA. Appropriate engine substitutions for the existing and projected aircraft fleet mixes at McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, Perkins Field Airport, and the South of Sloan Regional Heliport were determined based on a review of engine manufacturers' data.[4] For aircraft engines that did not have an obvious substitution correlation, a newer generation engine, for example the (CF6-50), was used in place of older generation engines (such as the JT3D and JT8D) for modeling purposes. It was also assumed that the older engine types would be phased out over time as a result of current noise and emissions regulations. **Table A-3** presents the aircraft engine substitution matrix developed for each aircraft/engine combination relevant to this inventory for which particulate emissions cannot be estimated in EDMS using the FOA.

Based on a review of engine manufactures' data, the TPE331-3 engine, manufactured by Allied Signal, was substituted for all propeller/turboprop-driven aircraft at the Clark County Airport System airports. The SPEY MK511 jet engine, manufactured by Rolls Royce, was substituted for business jet and regional jet aircraft engines. The CF6-50C engine, manufactured by General Electric, was substituted for engines powering the KC-135R tanker. The F100-PW-100 engine, manufactured by Pratt & Whitney, was used as a substitute for the F-16 military fighter/trainer aircraft engine.

[3] U.S. Environmental Protection Agency, *AP-42*, *Compilation of Air Pollutant Emission Factors,* Volume IV: "Mobile Sources", Fourth Edition, 1992.

[4] The methodology used to estimate aircraft PM10 at the Ivanpah airport is described in the *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport.*

Table A-3

Aircraft Engine Substitution Matrix

Aircraft Type	EDMS Engine Type	PM_{10} Engine Type	Number of Engines
Aztec	TIO-540-J2B2	TPE331-3	2
Bell 206	250B17B	TPE331-3	1
BH-1900C	PT6A-65B	TPE331-3	2
BH-C99	PT6A-27	TPE331-3	2
Cessna 150	O-200	TPE331-3	1
Cessna 172 Skyhawk	IO-320-D1AD	TPE331-3	1
Cessna 441 Conquest2	TPE331-8	TPE331-3	2
Cherokee Six	TIO-540-J2B2	TPE331-3	1
Comanche	TIO-540-J2B2	TPE331-3	1
DHC-6	PT6A-27	TPE331-3	2
DHC-6/300	PT6A-27	TPE331-3	2
DHC-8-400	PW123	TPE331-3	2
DO 328	PW119-B	TPE331-3	2
EMB-120	PW118	TPE331-3	2
F-16	F100-PW-100	SPEY MK511	1
F-27 Series	RDa7	TPE331-3	2
Gulfstream II	SPEY MK511-8	SPEY MK511	2
KC-135R	CFM56-2B	CF6-50C	4
King Air 200	PT6A-41	TPE331-3	2
Learjet 25B	CJ610-6	SPEY MK511	2
Learjet 35/36	TFE 731-2-2B	SPEY MK511	2
Navajo	TIO-540-J2B2	TPE331-3	2
SF-340-A	CT7-5	TPE331-3	2

Note:
Engine substitutions are based on aircraft/engine manufacturers substitutions.

Source: Ricondo & Associates, Inc., based on U.S. Environmental Protection Agency, *AP-42, Compilation of Air Pollutant Emission Factors*, Volume IV: "Mobile Sources", Fourth Edition, 1992.
Prepared by: Ricondo & Associates, Inc.

A.1.2.3 Particulate Emissions Calculations

The calculation of aircraft PM_{10} emissions requires three data items: time-in-mode (TIM), number of engines on each aircraft, and the emission factors for each engine type. TIM estimates are based on default values contained in EDMS with the exception of taxi/idle time, which was estimated using the methodology described in Section 3.1.3. **Equation A-1** was used to calculate particulate emissions for each aircraft type in this emissions inventory for which the FOA methodology was not applicable.

Equation A-1

Aircraft Particulate (PM_{10}) Emissions Calculation Equation

$$PM_m = (NE_a)(TIM_m)(EF_m)$$

Where:

PM_m = PM_{10} emissions from one aircraft type for mode *m* during one LTO cycle
NE_a = Number of engines on aircraft *a*
TIM_m = Time-in-mode in hours for specified mode *m* for a single engine
EF_m = Emission factor for the engine type in kilograms/hour for the specified mode *m*

After the particulate emissions were calculated for each mode, they were added together to determine total particulate emissions for each specified aircraft type per LTO cycle (PM_{LTO}).

$$PM_{LTO} = PM_{approach} + PM_{climbout} + PM_{takeoff} + PM_{taxi/idle}$$

The particulate emissions per LTO cycle (PM_{LTO}) were then multiplied by the annual number of LTO cycles to determine annual particulate emissions by aircraft type.

$$PM_{Total} = (PM_{LTO})(LTO_y)$$

Where:

PM_{Total} = Total particulate emissions per year for aircraft *y* (in kilograms)
LTO_y = Landing and takeoff cycles per year for aircraft *y*

Source: U.S. Environmental Protection Agency, *AP-42, Compilation of Air Pollutant Emission Factors,* Volume IV: "Mobile Sources", Fourth Edition, 1992.
Prepared by: Ricondo & Associates, Inc.

A.1.2.4 Integrating Calculated Particulate Emissions into EDMS

The AP-42 methodology, described in the previous section, allows aircraft-related PM_{10} emissions to be calculated for those aircraft/engine types for which the FOA methodology cannot be used in EDMS. Because the FOA algorithms are incorporated into EDMS, the resulting particulate emissions are included in the EDMS output files and emissions inventories, whereas emissions calculated using the AP-42 methodology are not.

One improvement in EDMS version 4.3 is the ability to edit particulate emission indices when the user creates a user-defined aircraft. This improvement allows a user to create an aircraft with an engine based on an engine in the EDMS database that lacks particulate data and to supplement the data with mathematically derived particulate emission indices. In this way, the user may create an aircraft type identical to the aircraft type to be modeled, with the only difference being that the user-defined aircraft type can be assigned a particulate emission index.

For the above methodology to work, an aircraft/engine-specific PM_{10} emission index is needed for each mode of operation. AP-42 provides PM_{10} emission factors (in kilograms/hour) for some engines, rather than emission indices (g/kg) required by EDMS. Therefore, PM_{10} emissions indices (by mode) must be derived for each aircraft/engine in the emissions inventory for which the FOA methodology cannot be applied. This derivation was accomplished by calculating PM_{10} emissions by mode for each aircraft/engine using the AP-42 methodology (Equation A-1) and then solving for a PM_{10} emission index using **Equation A-2**.

Equation A-2

Aircraft Emission Calculation Equation

$$EI_m = PM_m / [(60/1{,}000)(NE_a)(FF_m)(TIM_m)]$$

where:

EI_m	= Emission index of the engine type in g/kg of fuel burned for the specified mode *m*
PM_m	= PM_{10} emissions from one aircraft type for mode *m* during one LTO cycle
60	= Number of seconds per minute
1,000	= Number of grams per kilogram
NE_a	= Number of engines on aircraft *a*
FF_m	= Fuel flow rate of the engine type in kg/sec for the specified mode *m*
TIM_m	= Time-in-mode in hours for specified mode *m* for a single engine

Source: Ricondo & Associates, Inc., derived from Equation 4 in the FAA's *Technical Manual for the Emissions and Dispersion Modeling System (EDMS) Version 4.2*, July 5, 2005.
Prepared by: Ricondo & Associates, Inc.

Table A-4 presents the user-defined aircraft created for this study, including the PM_{10} emission indices, by mode, calculated for each aircraft/engine type using Equation A-2. These user-defined aircraft with particulate emission indices were entered into EDMS.

Table A-4

User-Defined Aircraft with Calculated Particulate Emission Indices

Aircraft Name [1/]	Number of Engines	Aircraft Category [2/]	Flight Profile [3/] Aircraft	Flight Profile [3/] Engine	EDMS Engine [4/]	Particulate Emission Indices by Mode (g/kg) [5/] Takeoff	Climbout	Approach	Taxi/Idle
Aztec	2	SGPB	Aztec	TIO-540-J2B2	TIO-540-J2B2	5.987481	2.904288	3.049858	12.288710
Bell 206	1	SGTH	B767-300	CF6-80A2	250B17B	6.803955	2.422120	2.987765	4.912373
BH-1900C	2	SCTP	BH-1900C	PT6A-65B	PT6A-65B	1.799123	1.054134	1.267997	1.724789
BH-C99	2	SCTP	BH-C99	PT6A-27	PT6A-27	3.054837	1.644912	1.937696	2.694982
Cessna 150	1	SGPP	Cessna 150	O-200	O-200	23.293965	13.151205	17.534940	37.315140
Cessna 172 Skyhawk	1	SGPP	Cessna 172 Skyhawk	IO-320-D1AD	IO-320-D1AD	15.776456	9.674704	8.639943	39.239379
Cessna 441 Conqst2	2	SGTP	Cessna 441 Conquest2	TPE331-8	TPE331-8	1.985239	1.406833	1.763098	2.694982
Cherokee six	1	SGPP	Cherokee Six	TIO-540-J2B2	TIO-540-J2B2	5.987481	2.904288	3.049858	12.288710
Comanche	1	SGPP	Comanche	TIO-540-J2B2	TIO-540-J2B2	5.987481	2.904288	3.049858	12.288710
DHC-6	2	SCTP	DHC-6	PT6A-27	PT6A-27	3.054837	1.644912	1.937696	2.694982
DHC-6/300	2	SCTP	DHC-6/300	PT6A-27	PT6A-27	3.054837	1.644912	1.937696	2.694982
DHC-8-400	2	LCTP	DHC-8-400	PW123	PW123	1.003264	0.564857	0.671543	0.762431
DO 328	2	SCTP	DO 328	PW119-B	PW119-B	0.728510	0.510572	0.456606	0.102287
EMB-120	2	SCTP	EMB-120	PW118	PW118	1.175306	0.710765	0.838583	0.921799
F-16	1	SMJA	F-16	F100-PW-100	F100-PW-100	0.400656	1.126470	0.000000	0.100289
F-27 SERIES	2	LMTC	F-27 SERIES	RDa7	RDa7	0.919228	0.476710	0.560626	0.750633
Gulfstream II	2	LCJP	Gulfstream II	SPEY MK511-8	SPEY MK511-8	0.678039	1.718171	2.271096	0.168065
KC-135R	4	HMJC	KC-135R	CFM56-2B	CFM56-2B	0.172173	0.079481	0.066395	0.045073
King Air 200	2	SCTP	King Air 200	PT6A-41	PT6A-41	2.175683	1.255764	1.551965	2.097716
Learjet 25B	2	SGJB	Learjet 25B	CJ610-6	CJ610-6	1.461200	4.331222	5.781562	0.333504
Learjet 35/36	2	SGJB	Learjet 35/36	TFE 731-2-2B	TFE 731-2-2B	2.813355	7.210357	9.870960	0.889344
Navajo	2	SGPB	Navajo	TIO-540-J2B2	TIO-540-J2B2	5.987481	2.904288	3.049858	12.288710
SF-340-A	2	SCTP	SF-340-A	CT7-5	CT7-5	1.663189	0.796208	0.988033	2.587183

Notes:

1/ User-defined aircraft were named based on the EDMS aircraft they were intended to emulate.

2/ First letter indicates size, second letter indicates designation, third letter indicates engine type, fourth letter indicates usage. HMJC = heavy, military, jet, cargo/transport; LCJP = light, commercial, jet, passenger; LCTP = light, commercial, turboprop, passenger; LMTC = light, military, turboprop, cargo/transport; SCTP = small, commercial, turboprop, passenger; SGJB = small, general aviation, jet, business; SGPB = small, general aviation, piston, business; SGPP = small, general aviation, propeller, passenger; SGTH = small, general aviation, turboprop, helicopter; SGTP = small, general aviation, turboprop, passenger; SMJA = small, military, jet, attack/combat.

3/ An aircraft-engine flight profile was assigned to each user-defined aircraft that matches the EDMS aircraft to be emulated.

4/ Each user-defined aircraft was assigned an EDMS engine, which provided emission indices for all pollutants except particulates.

5/ Particulate emission indices are identical for PM_{10} and $PM_{2.5}$.

Source: Ricondo & Associates, Inc. using data from the Emissions and Dispersion Modeling System (EDMS) version 4.3.

Prepared by: Ricondo & Associates, Inc.

Appendix B Landing and Takeoff Cycles and Aircraft Fleet Mix Data

This appendix contains information about aircraft landing and takeoff (LTO) cycles and fleet mixes at the aviation facilities managed by the Clark County Department of Aviation, including: McCarran International Airport, North Las Vegas Airport, Henderson Executive Airport, Jean Airport, and Perkins Field Airport. Similar data are provided for proposed aviation facilities, including the South of Sloan Regional Heliport and Ivanpah Airport. This information is presented in **Tables B-1** through **B-9**.

Table B-1 (1 of 2)

Annual Aircraft LTO Cycles and Fleet Mix, McCarran International Airport—2002

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/]
Heavy Air Carrier Jet			
B-747/777	B747-200	JT9D-7Q	284
A300/310/330	A300B	CF6-50C	650
L-1011	L-1011-100	RB211-22B	273
DC-10	DC10-30	CF6-50C2	1,426
B-767	B767-200ER	PW4060	3,383
707	707-120	JT3D-7	12
VC-10	KC135R	CFM56-2B	4
Subtotal			6,031
Air Carrier Jet			
B-727-200	B727-200	JT8D-9A	655
	B727-200	JT8D-9	110
	B727-200	JT8D-15	3,560
	B727-200	JT8D-17	162
B-737-200	B737-200	JT8D-17	67
	B737-200	JT8D-15	3,064
	B737-200	JT8D-9A	2,912
B-737-300	B737-300	CFM56-3C-1	7,470
	B737-300	CFM56-3B-2	1,443
	B737-300	CFM56-3-B1	42,601
B-737-400	B737-400	CFM56-3C-1	1,784
B-737-500	B737-500	CFM56-3C-1	2,554
	B737-500	CFM56-3-B1	5,931
B-737-700	B737-700	CFM56-7B22	18,792
	B737-700	CFM56-7B24	622
B-737-800	B737-800	CFM56-7B26	3,587
B-737-900	B737-900	CFM56-7B26	1,576
B-757	B757-200	RB211-535C	15,106
	B757-200	PW2040	1,942
	B757-200	PW2037	15,755
A-319	A319	V2524-A5	5,393
	A319	CFM56-5B6/P	3,277
A-320	A320	CFM56-5B4	1,741
	A320	V2500A-1	10,610
MD-80	MD80	JT8D-219	4,437
	MD80	JT8D-217	7,038
DC-9-30	DC9-30	JT8D-17	346
Canadair	Reg-100	CF34-3A1	805
Subtotal			163,338

Table B-1 (2 of 2)

Annual Aircraft LTO Cycles and Fleet Mix, McCarran International Airport—2002

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/]
Commuter Propeller			
Dash-6	DHC-6	PT6A-27	6
Dash-8-400	DHC-8-400	PW123	6
F-27	F-27 SERIES	RDa7	1,233
SF-340	SF-340-A	CT7-5	1,237
EMB-120	EMB-120	PW118	3
Beech-99	BH-C99	PT6A-27	1,910
Subtotal			4,395
Business Jet			
Large stage 2	Gulfstream II	SPEY MK511-8	1,057
Medium / small stage 2	Learjet 25B	CJ610-6	1,805
Large stage 3	Gulfstream IV	TAY Mk611-8	5,988
Medium / small stage 3	Learjet 35/36	TFE 731-2-2B	10,228
Subtotal			19,077
General Aviation / Military Propeller			
Twin engine turboprop	Kingair 200	PT6A-41	2,694
Twin engine piston prop	Aztec	TIO-540-J2B2	9,922
Single engine piston prop	Cherokee six	TIO-540-J2B2	8,340
Subtotal			20,956
Air Tour / GA Helicopters	Bell 206	250B17B	34,598
Military Fighter / Trainer	F16	F100-PW-100	29
Total Annual LTO Cycles			248,423

Notes:

LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

1/ LTO cycle subtotals may not equal the sum of individual aircraft LTO cycles due to rounding.

Source: Ricondo & Associates, Inc. *2002 Airport Emissions Inventories, McCarran International, North Las Vegas, and Henderson Executive Airports.* April 2004.

Prepared by: Ricondo & Associates, Inc.

Table B-2 (1 of 3)

Annual Aircraft LTO Cycles and Fleet Mix, McCarran International Airport—2003 through 2018

			Annual LTO Cycles [1/]			
Aircraft Type	EDMS Type	Engine Type	2003	2008	2013	2018
Heavy Air Carrier Jet						
A306, A310, A331, A332, A343	A300B	CF6-50C	471	934	1,188	1,716
B744, B742	B747-400	PW4056	314	762	1,414	2,117
B762, B763, B764, B767, B769	B767-200ER	PW4060	357	429	560	693
		CF6-80A2	1,777	2,135	2,783	3,445
		CF6-80C2B7F	1,160	1,394	1,817	2,249
B777	B777-300	PW4098	0	190	450	657
B7E7	B777-200	TRENT-890	0	437	1,228	2,154
DC10, L101, MD10, MD11	DC10-30	CF6-50C2	785	260	0	0
Subtotal			4,864	6,541	9,440	13,031
Air Carrier Jet						
A318, A319	A319	CFM56-5A5	392	507	669	817
		V2522-A5	949	1,226	1,618	1,975
		V2524-A5	7,127	9,206	12,152	14,837
A32, A320, A321	A320	CFM56-5B4	1,195	2,189	2,338	2,284
		V2500-A1	3,948	7,234	7,726	7,546
		V2527-A5	12,578	23,048	24,616	24,043
B717	B717-200	BR700-715C1-30	0	900	1,146	1,314
B721, B722, B727, B727Q	B727-200	JT8D-15	1,881	1,486	574	0
B732, B73Q, B73S	B737-200	JT8D-15	4,548	3,631	797	0
B733	B737-300	CFM56-3-B1	34,944	40,406	45,133	47,405
		CFM56-3B-2	6,245	7,221	8,066	8,472
		CFM56-3C-1	4,604	5,324	5,946	6,246
B734	B737-400	CFM56-3C-1	1,568	729	229	0
B735	B737-500	CFM56-3C-1	5,019	2,282	1,037	0
B737	B737-700	CFM56-7B22	24,017	35,588	42,823	47,587
		CFM56-7B24	447	662	797	885

Table B-2 (2 of 3)

Annual Aircraft LTO Cycles and Fleet Mix, McCarran International Airport—2003 through 2018

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/] 2003	2008	2013	2018
Air Carrier Jet (cont.)						
B738, B739	B737-800	CFM56-7B26	5,646	6,335	7,478	9,380
B751, B752, B753, B757	B757-200	PW2037	10,627	12,227	13,265	14,031
		RB211-535E4	8,668	9,973	10,820	11,444
		RB211-535E4B	5,640	6,490	7,041	7,447
CR7, CR9, E170, E190	Embraer ERJ 170	CF34-8E2	0	6,217	11,926	20,075
CRJ-200, E135, E145	Embraer ERJ 145	AE3007A	2,622	3,311	3,603	4,161
DC9, DC93, DC9Q	DC9-30	JT8D-17	314	489	586	438
MD80, MD81, MD87	MD-80	JT8D-217	3,294	4,413	4,554	4,672
MD82	MD-80-82	JT8D-217A	2,648	2,255	2,350	1,998
		JT8D-217C	1,900	1,618	1,686	1,433
MD83, MD88	MD-80-83	JT8D-219	2,823	2,749	2,595	2,482
MD90	MD-90-10	V2522-D5	942	1,037	1,062	1,132
Subtotal			154,586	198,753	222,633	242,104
Commuter Propeller						
E120	EMB-120	PW118	2,155	3,012	4,142	4,781
Large Twin Turboprop	DHC-6	PT6A-27	1,498	1,263	2,560	2,956
Subtotal			3,653	4,275	6,702	7,737
Business Jet						
Large Stage 2	Gulfstream II	SPEY MK511-8	1,500	1,148	895	876
Large Stage 3	Gulfstream IV	TAY Mk611-8	8,994	6,629	5,399	5,366
Medium / Small Stage 2	Learjet 25B	CJ610-6	2,623	1,628	1,547	1,533
Medium / Small Stage 3	Learjet 35 / 36	TFE 731-2-2B	15,272	10,276	9,195	9,088
Subtotal			28,389	19,681	17,036	16,863

Table B-2 (3 of 3)

Annual Aircraft LTO Cycles and Fleet Mix, McCarran International Airport—2003 through 2018

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/] 2003	2008	2013	2018
General Aviation / Helicopters / Military						
General Aviation						
Single-engine Prop	Cherokee Six	TIO-540-J2B2	12,366	7,442	7,441	7,373
Twin Piston Prop	Aztec	TIO-540-J2B2	14,802	8,110	8,930	8,797
Twin Turboprop	King Air 200	PT6A-41	4,028	2,568	2,609	2,409
Air Tour / Helicopters [2/]	Bell 206	250B17B	27,638	52,370	19,300	22,100
Military Fighter/Trainer	F-16	F100-PW-100	188	165	133	109
Subtotal			59,022	70,655	38,413	40,788
Total			250,514	299,905	294,224	320,523

Notes:
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
1/ LTO cycle subtotals may not equal the sum of individual aircraft LTO cycles due to rounding.
2/ For the analysis both the Eurocopter AS350 and the EC130 were assumed to have the same EDMS aircraft and engine type. Therefore, operations / LTOs for these aircraft were combined.

Sources: Ricondo & Associates, Inc. and the sources noted in Section III.
Prepared by: Ricondo & Associates, Inc.

Table B-3

Annual Aircraft LTO Cycles and Fleet Mix, North Las Vegas Airport—2002 through 2018

Aircraft Type	EDMS Type	Engine Type	2002 Annual LTO Cycles 1/	2002 Annual TG Cycles	2003 Annual LTO Cycles 1/	2003 Annual TG Cycles	2008 Annual LTO Cycles 1/	2008 Annual TG Cycles	2013 Annual LTO Cycles 1/	2013 Annual TG Cycles	2018 Annual LTO Cycles 1/	2018 Annual TG Cycles
Itinerant Operations												
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	6,906	0	7,061	0	7,123	0	7,287	0	7,592	0
Single-engine Piston Prop	Cessna 150	O-200	19,263	0	19,694	0	19,867	0	20,325	0	21,176	0
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	5,571	0	5,695	0	5,745	0	5,878	0	6,124	0
Twin-engine Turboprop	King Air 200	PT6A-41	894	0	914	0	922	0	943	0	983	0
Twin-engine Turboprop	DHC-6 / 300	PT6A-27	894	0	914	0	922	0	943	0	983	0
Business Jet	Lear 35 / 36	TFE-731-2-2B	859	0	879	0	886	0	907	0	945	0
Subtotal			34,388	0	35,156	0	35,464	0	36,282	0	37,801	0
Local Operations												
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	0	12,267	0	11,804	0	11,546	0	11,742	0	11,812
Single-engine Piston Prop	Cessna 150	O-200	0	33,115	0	31,865	0	31,170	0	31,698	0	31,888
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	0	9,438	0	9,082	0	8,884	0	9,035	0	9,089
Twin-engine Turboprop	King Air 200	PT6A-41	0	1,696	0	1,632	0	1,596	0	1,623	0	1,633
Twin-engine Turboprop	DHC-6 / 300	PT6A-27	0	0	0	0	0	0	0	0	0	0
Subtotal			0	56,516	0	54,382	0	53,197	0	54,098	0	54,423
Air Taxi Operations												
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	627	0	822	0	2,439	0	2,593	0	2,757	0
Single-engine Turboprop	King Air 200	PT6A-41	933	0	1,223	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	9,397	0	12,318	0	2,439	0	2,593	0	2,757	0
Twin-engine Turboprop	DHC-6 / 300	PT6A-27	7,287	0	9,552	0	11,710	0	12,448	0	13,234	0
Twin-engine Turboprop	BH-1900C	PT6A-65B	n.a.	n.a.	n.a.	n.a.	3,903	0	4,149	0	4,411	0
Twin-engine Turboprop	DO 328	PW119B	n.a.	n.a.	n.a.	n.a.	3,903	0	4,149	0	4,411	0
Subtotal			18,245	0	23,916	0	24,395	0	25,934	0	27,570	0
Total			52,633	56,516	59,072	54,382	59,859	53,197	62,216	54,098	65,371	54,423

Notes:
n.a. = Not applicable
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
TG = Touch-and-go training operation. One touch-and-go operation equals two local operations.
1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.

Sources: Ricondo & Associates, Inc., and the sources noted in Section III.
Prepared by: Ricondo & Associates, Inc.

Table B-4

Annual Aircraft LTO Cycles and Fleet Mix, Henderson Executive Airport – 2002

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/]	Annual TG Cycles
Itinerant Operations				
Single-engine Piston Prop	Cherokee six	TIO-540-J2B2	4,467	0
Single-engine Piston Prop	Cessna 150	O-200	5,956	0
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	1,936	0
Twin-engine Turboprop	King Air 200	PT6A-41	1,042	0
Business Jet	Lear 35 / 36	TFE-731-2-2B	1,489	0
Subtotal			14,891	0
Local Operations [2/]				
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	0	5,964
Single-engine Piston Prop	Cessna 150	O-200	0	8,645
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	0	1,631
Subtotal			0	16,240
Air Tour Operations				
Single-engine Piston Prop	Cherokee six	TIO-540-J2B2	1,045	0
Single-engine Turboprop	King Air 200 [3/]	PT6A-41	1,447	0
Twin-engine Turboprop	Dash 6	PT6A-27	4,100	0
Subtotal			6,593	0
Total			21,483	16,240

Notes:

LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

TG = Touch-and-go training operation. One touch-and-go operation equals two local operations.

1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.

2/ Local aircraft operations are touch-and-go operations, not LTO cycles.

3/ Modeled in EDMS as a King Air 200 with operations divided by 2 to adjust to a single engine.

Sources: Ricondo & Associates, Inc., and the sources noted in Section III.

Prepared by: Ricondo & Associates, Inc.

Table B-5

Annual Aircraft LTO Cycles and Fleet Mix, Henderson Executive Airport — 2003 through 2018

			2003		2008		2013		2018	
Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/]	Annual TG Cycles	Annual LTO Cycles [1/]	Annual TG Cycles	Annual LTO Cycles [1/]	Annual TG Cycles	Annual LTO Cycles [1/]	Annual TG Cycles
Itinerant Operations										
General Aviation Jet	Learjet 35 / 36	TFE 731-2-2B	890	0	1,244	0	1,575	0	1,995	0
Twin-engine Turboprop	Cessna 441 Conquest2	TPE331-8	890	0	1,244	0	1,575	0	1,995	0
Twin-engine Prop	Navajo	TIO-540-J2B2	3,718	0	5,195	0	6,575	0	8,330	0
Single-engine Prop - Variable	Comanche	TIO-540-J2B2	812	0	1,135	0	1,436	0	1,820	0
Single-engine Prop - Fixed	Cherokee Six	TIO-540-J2B2	7,263	0	10,149	0	12,846	0	16,276	0
Helicopter	Bell 206	250B17B	937	0	1,309	0	1,657	0	2,100	0
Subtotal			14,510	0	20,276	0	25,664	0	32,516	0
Local Operations [2/]										
Twin-engine Prop	Navajo	TIO-540-J2B2	0	1,787	0	2,575	0	3,260	0	4,130
Single-engine Prop - Variable	Comanche	TIO-540-J2B2	0	1,666	0	2,401	0	3,039	0	3,850
Single-engine Prop - Fixed	Cherokee Six	TIO-540-J2B2	0	14,569	0	20,997	0	26,575	0	33,671
Subtotal			0	18,022	0	25,973	0	32,874	0	41,651
Air Tour Operations										
Twin-engine Prop	Navajo	TIO-540-J2B2	2,232	0	3,197	0	3,390	0	3,596	0
Single-engine Prop – Tour	Cessna 172 Skyhawk	IO-320-D1AD	1,814	0	2,598	0	2,754	0	2,921	0
Helicopter	Bell 206	250B17B	0	0	0	0	4,700	0	5,700	0
Subtotal			4,046	0	5,795	0	10,844	0	12,217	0
Total			18,556	18,022	26,071	25,973	36,508	32,874	44,733	41,651

Notes:
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
TG = Touch-and-go training operation. One touch-and-go operation equals two local operations.
1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.
2/ Local aircraft operations are touch-and-go operations, not LTO cycles.

Sources: Ricondo & Associates, Inc., and the sources noted in Section III.
Prepared by: Ricondo & Associates, Inc.

Table B-6

Annual Aircraft LTO Cycles and Fleet Mix, Jean Airport—2002 through 2018

			2002		2003		2008		2013		2018	
Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles 1/	Annual TG Cycles	Annual LTO Cycles 1/	Annual TG Cycles	Annual LTO Cycles 1/	Annual TG Cycles	Annual LTO Cycles 1/	Annual TG Cycles	Annual LTO Cycles 1/	Annual TG Cycles
Itinerant Operations												
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	6,176	0	6,176	0	6,176	0	6,176	0	6,176	0
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	1,324	0	1,324	0	1,324	0	1,324	0	1,324	0
Subtotal			7,500	0	7,500	0	7,500	0	7,500	0	7,500	0
Local Operations												
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	0	2,059	0	2,059	0	2,059	0	2,059	0	2,059
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	0	441	0	441	0	441	0	441	0	441
Subtotal			0	2,500	0	2,500	0	2,500	0	2,500	0	2,500
Total			7,500	2,500	7,500	2,500	7,500	2,500	7,500	2,500	7,500	2,500

Notes:
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
TG = Touch-and-go training operation. One touch-and-go operation equals two local operations.
1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.

Sources: Ricondo & Associates, Inc., and the sources noted in Section III.
Prepared by: Ricondo & Associates, Inc.

Table B-7

Annual Aircraft LTO Cycles and Fleet Mix, Perkins Field Airport—2002 through 2018

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/] 2002	2003	2008	2013	2018
Itinerant Operations							
Single-engine Piston Prop	Cherokee Six	TIO-540-J2B2	2158	2,158	2158	2,158	2,158
Twin-engine Piston Prop	Piper Navajo	TIO-540-J2B2	442	442	442	442	442
Total			2,600	2,600	2,600	2,600	2,600

Notes:
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.

Source: Ricondo & Associates, Inc., based on information provided by the Clark County Department of Aviation.
Prepared by: Ricondo & Associates, Inc.

Table B-8

Annual Helicopter LTO Cycles and Fleet Mix, South of Sloan Regional Heliport—2013 and 2018

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/] 2013	2018
Air Tour / GA Helicopters [2/]	Bell 206	250B17B	31,900	38,800

Notes:
LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.
GA = General aviation
1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.
2/ For analysis years 2003, 2008, 2013, and 2018, the Eurocopter AS350 and the EC130 were assumed to have the same EDMS aircraft and engine type. Therefore, operations / LTOs for these aircraft types were combined.

Sources: Ricondo & Associates, Inc., and the sources noted in Section III.
Prepared by: Ricondo & Associates, Inc.

Table B-9

Annual Aircraft LTO Cycles and Fleet Mix, Ivanpah Airport--2018

Aircraft Type	EDMS Type	Engine Type	Annual LTO Cycles [1/]
Heavy Air Carrier Jet			
B767	B767-300	CF6-80A2	5,642
B777	B777-200	PW4077	5,642
Subtotal			11,284
Air Carrier Jet			
A320	A320	V2527-A5	27,084
A321	A321	V2533-A5	27,084
B717	B717-200	BR700-715A1-30 new FI	37,240
B737	B737-300	CFM56-3-B1	37,240
B757	B757-200	PW2037	27,084
DC9	DC9-20	JT8D-11	4,350
Subtotal			160,082
Commuter Propeller			
Single Prop	Cessna 150	O-200	1,812
Turboprop	Cessna 441 Conquest2	TPE331-8	3,581
Dual Prop	Comanche	TIO-540-J2B2	2,642
Dash-8	Dash 8-300	PW123	2,700
Subtotal			10,735
Business Jet			
Lear 24	Learjet 24D	CJ610-6	1,332
General Aviation / Military Propeller			
C-130	C-130 Hercules	T56 series I	632
Total			184,065

Notes:

LTO = Landing and takeoff. One LTO cycle equals two operations: a landing and a takeoff.

TG = Touch-and-go training operation. One touch-and-go operation equals two local operations.

1/ LTO subtotals may not equal the sum of individual aircraft LTOs due to rounding.

Source: MWH Americas, Inc., *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.

Prepared by: Ricondo & Associates, Inc.

Appendix C Input for Regional Dispersion Modeling

This appendix contains latitude/longitude coordinates for minor point sources at the existing and proposed aviation facilities considered in this report and includes recommendations regarding the apportionment of emissions from airport-related mobile sources (e.g., aircraft, ground support equipment, and on-road motor vehicles) to dispersion modeling grid cells developed by the Clark County Department of Air Quality and Environmental Management (DAQEM).

Tables C-1 through **C-8** present latitude/longitude data for the point sources at the airport/heliport facilities and summarize pollutant emissions from each point source. These data are provided in support of future dispersion modeling to be conducted by the DAQEM.

Exhibits C-1 through **C-7** depict the locations of DAQEM's dispersion modeling grid cells with respect to the airport facilities. The location of major roads and other landmarks are also shown on the exhibits. **Table C-9** presents recommendations regarding the apportionment of emissions from airport-related mobile sources. The grid cells listed in Table C-9 are intended to be inclusive and represent where emissions (either now or in the future) could result from airport-related sources. It was assumed that DAQEM will evenly distribute the annual emission estimates over all grid cells relevant to a particular source category as listed in Table C-9. **Tables C-10** through **C-15** present latitude/longitude coordinates for the center point of the relevant grid cells based on information extracted from DAQEM's geographic information system (GIS) database.

Table C-1

Latitude/Longitude Coordinates for Point Sources, McCarran International Airport

Emission Source	Category	Annual Emissions Estimate by Pollutant (Tons) CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	Latitude	Longitude
ARFF Generator 1	Power/Heat Plant	0.037	0.014	0.173	0.011	0.012	0.012	36.082212109	115.156955770
ARFF Generator 2	Power/Heat Plant	0.010	0.003	0.043	0.003	0.003	0.003	36.082212109	115.156955770
ARFF Tank 1	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.082212109	115.156955770
ARFF Tank 2	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.082212109	115.156955770
Bridge Area Generator	Power/Heat Plant	0.019	0.007	0.087	0.006	0.007	0.007	36.084203447	115.151482539
Bridge Area Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084203447	115.151482539
CIT Generator	Power/Heat Plant	0.013	0.004	0.061	0.004	0.004	0.004	36.089449645	115.153521870
CIT Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.089449645	115.153521870
Degreasers	Solvent Degreaser	0.000	4.874	0.000	0.000	0.000	0.000	36.099376782	115.150912071
East Airfield Generator	Power/Heat Plant	0.010	0.003	0.043	0.003	0.003	0.003	36.079685272	115.152505597
East Airfield Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.079685272	115.152505597
Heating and Refrigeration Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084101513	115.146853195
Heating and Refrigeration Plant 1	Power/Heat Plant	0.226	0.084	1.043	0.069	0.074	0.074	36.084101513	115.146853195
Heating and Refrigeration Plant 2	Power/Heat Plant	0.226	0.084	1.043	0.069	0.074	0.074	36.084101513	115.146853195
Heating and Refrigeration Tank 2	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084101513	115.146853195
North Finger Generator	Power/Heat Plant	0.011	0.004	0.052	0.003	0.003	0.003	36.085468213	115.153306630
North Finger Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.085468213	115.153306630
Paint Booth 1	Surface Coating (Topcoat)	0.000	0.053	0.000	0.000	0.000	0.000	36.099376782	115.150912071
Paint Booth 2	Surface Coating (Topcoat)	0.000	0.065	0.000	0.000	0.000	0.000	36.099376782	115.150912071
Paint Booth 3	Solvent Degreaser	0.000	0.007	0.000	0.000	0.000	0.000	36.099376782	115.150912071
Paint Booth 4	Surface Coating (Prime Coat)	0.000	0.024	0.000	0.000	0.000	0.000	36.099376782	115.150912071
Rotunda Generator	Power/Heat Plant	0.019	0.007	0.087	0.006	0.007	0.007	36.084453778	115.150814434
Rotunda Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084453778	115.150814434
Satellite 1 Generator	Power/Heat Plant	0.029	0.010	0.130	0.009	0.009	0.009	36.079761722	115.146305245
Satellite 1 Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.079761722	115.146305245
South Finger Generator	Power/Heat Plant	0.114	0.042	0.521	0.034	0.037	0.037	36.082786577	115.151669659
South Finger Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.082786577	115.151669659
Vehicle Tank 1	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.098399771	115.150423208
Vehicle Tank 2	Fuel Tank	0.000	1.502	0.000	0.000	0.000	0.000	36.098399771	115.150423208

Notes:

ARFF = Aircraft rescue and fire fighting

CIT = Charter International Terminal

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table C-2

Latitude/Longitude Coordinates for Point Sources Associated with Terminal 3, McCarran International Airport

Emission Source [/1]	Category	Annual Emissions Estimate by Pollutant (Tons)						Latitude	Longitude
		CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$		
T3 Degreasers	Solvent Degreaser	0.000	4.874	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Generator 1	Power/Heat Plant	0.011	0.004	0.052	0.003	0.003	0.003	36.084458552	115.132724551
T3 Generator 2	Power/Heat Plant	0.019	0.007	0.087	0.006	0.007	0.007	36.085484527	115.134529397
T3 Generator 3	Power/Heat Plant	0.114	0.042	0.521	0.034	0.037	0.037	36.085495203	115.137389229
T3 Heating and Refrigeration Plant 1	Power/Heat Plant	0.226	0.084	1.043	0.069	0.074	0.074	36.085484527	115.134529397
T3 Heating and Refrigeration Plant 2	Power/Heat Plant	0.226	0.084	1.043	0.069	0.074	0.074	36.085495203	115.137389229
T3 Heating and Refrigeration Tank 1	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.085484527	115.134529397
T3 Heating and Refrigeration Tank 2	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.085495203	115.137389229
T3 Paint Booth 1	Surface Coating	0.000	0.053	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Paint Booth 2	Surface Coating	0.000	0.065	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Paint Booth 3	Solvent Degreaser	0.000	0.007	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Paint Booth 4	Surface Coating	0.000	0.024	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Tank 1	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Tank 2	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.085484527	115.134529397
T3 Tank 3	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.085495203	115.137389229
T3 Vehicle Tank 1	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.084458552	115.132724551
T3 Vehicle Tank 2	Fuel Tank	0.000	1.502	0.000	0.000	0.000	0.000	36.084458552	115.132724551

Notes:

1/ These sources were included in the 2013 and 2018 emission inventories prepared for McCarran International Airport.

Source: Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc.

Table C-3

Latitude/Longitude Coordinates for Point Sources, North Las Vegas Airport

Emission Source	Category	Annual Emissions Estimate by Pollutant (Tons)						Latitude	Longitude
		CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$		
80 Octane Fuel truck	Gasoline Tank	0.000	0.240	0.000	0.000	0.000	0.000	36.208789608	115.199073131
ATCT Emergency Backup Generator	Power/Heat Plant	0.020	0.008	0.094	0.007	0.007	0.007	36.206140069	115.196109941
ATCT Emergency Backup Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.206140069	115.196109941
Jet A Tank #1	Jet Fuel	0.000	0.009	0.000	0.000	0.000	0.000	36.210321462	115.199604631
Jet A Tank #2	Jet Fuel	0.000	0.002	0.000	0.000	0.000	0.000	36.210321462	115.199604631
Jet A Tank #3	Jet Fuel	0.000	0.021	0.000	0.000	0.000	0.000	36.210321462	115.199604631
Light Trailer Generator	Power/Heat Plant	0.006	0.002	0.023	0.001	0.002	0.002	36.206140069	115.196109941
Light Trailer Tank	Fuel Tank	0.000	0.000	0.000	0.000	0.000	0.000	36.206140069	115.196109941
Low Lead Fuel Tank #1	Aviation Gasoline	0.000	4.518	0.000	0.000	0.000	0.000	36.209782535	115.200308959
Low Lead Fuel Tank #2	Aviation Gasoline	0.000	4.518	0.000	0.000	0.000	0.000	36.209782535	115.200308959
Low Lead Fuel Truck #1	Aviation Gasoline	0.000	1.700	0.000	0.000	0.000	0.000	36.208789608	115.199073131
Low Lead Fuel Truck #2	Aviation Gasoline	0.000	0.432	0.000	0.000	0.000	0.000	36.208789608	115.199073131
Low Lead Fuel Truck #3	Aviation Gasoline	0.000	1.327	0.000	0.000	0.000	0.000	36.208789608	115.199073131
Low Lead Fuel Truck #4	Aviation Gasoline	0.000	0.400	0.000	0.000	0.000	0.000	36.208789608	115.199073131
Low Lead Fuel Truck #5	Aviation Gasoline	0.000	0.349	0.000	0.000	0.000	0.000	36.208789608	115.199073131
Unleaded Tank	Gasoline Tank	0.000	0.087	0.000	0.000	0.000	0.000	36.209735769	115.200288848

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-4

Latitude/Longitude Coordinates for Point Sources, Henderson Executive Airport

Emission Source	Category	Annual Emissions Estimate by Pollutant (Tons)						Latitude	Longitude
		CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$		
Jet A Tank #1	Jet A Fuel	0.000	0.010	0.000	0.000	0.000	0.000	35.975481298	115.139005920
Jet A Tank #2	Jet A Fuel	0.000	0.010	0.000	0.000	0.000	0.000	35.975382400	115.139006474
Avgas Tank #1	Aviation Gasoline	0.000	0.410	0.000	0.000	0.000	0.000	35.975481298	115.139005920
Avgas Tank #2	Aviation Gasoline	0.000	1.099	0.000	0.000	0.000	0.000	35.975382400	115.139006474
Vehicle Refuel Tank	Gasoline Tank	0.000	0.043	0.000	0.000	0.000	0.000	35.975382400	115.139006474

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-5

Latitude/Longitude Coordinates for Point Sources, Jean Airport

Emission Source	Category	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	Latitude	Longitude
		Annual Emissions Estimate by Pollutant (Tons)							
Self-serve Fuel Island	Aviation Gasoline	0.000	0.026	0.000	0.000	0.000	0.000	35.770621715	115.329836792

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-6

Latitude/Longitude Coordinates for Point Sources, Perkins Field Airport

Emission Source	Category	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	Latitude	Longitude
		Annual Emissions Estimate by Pollutant (Tons)							
Fuel Pump	Aviation Gasoline	0.000	0.007	0.000	0.000	0.000	0.000	36.561216540	114.441205773
Future Self-Serve Fuel Island	Aviation Gasoline	0.000	0.007	0.000	0.000	0.000	0.000	36.561377558	114.440900803

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-7

Latitude/Longitude Coordinates for Point Sources, South of Sloan Regional Heliport

Emission Source	Category	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	Latitude	Longitude
		Annual Emissions Estimate by Pollutant (Tons)							
Fuel Tank	Jet Kerosene	0.000	0.004	0.000	0.000	0.000	0.000	35.763534651	115.3281417292

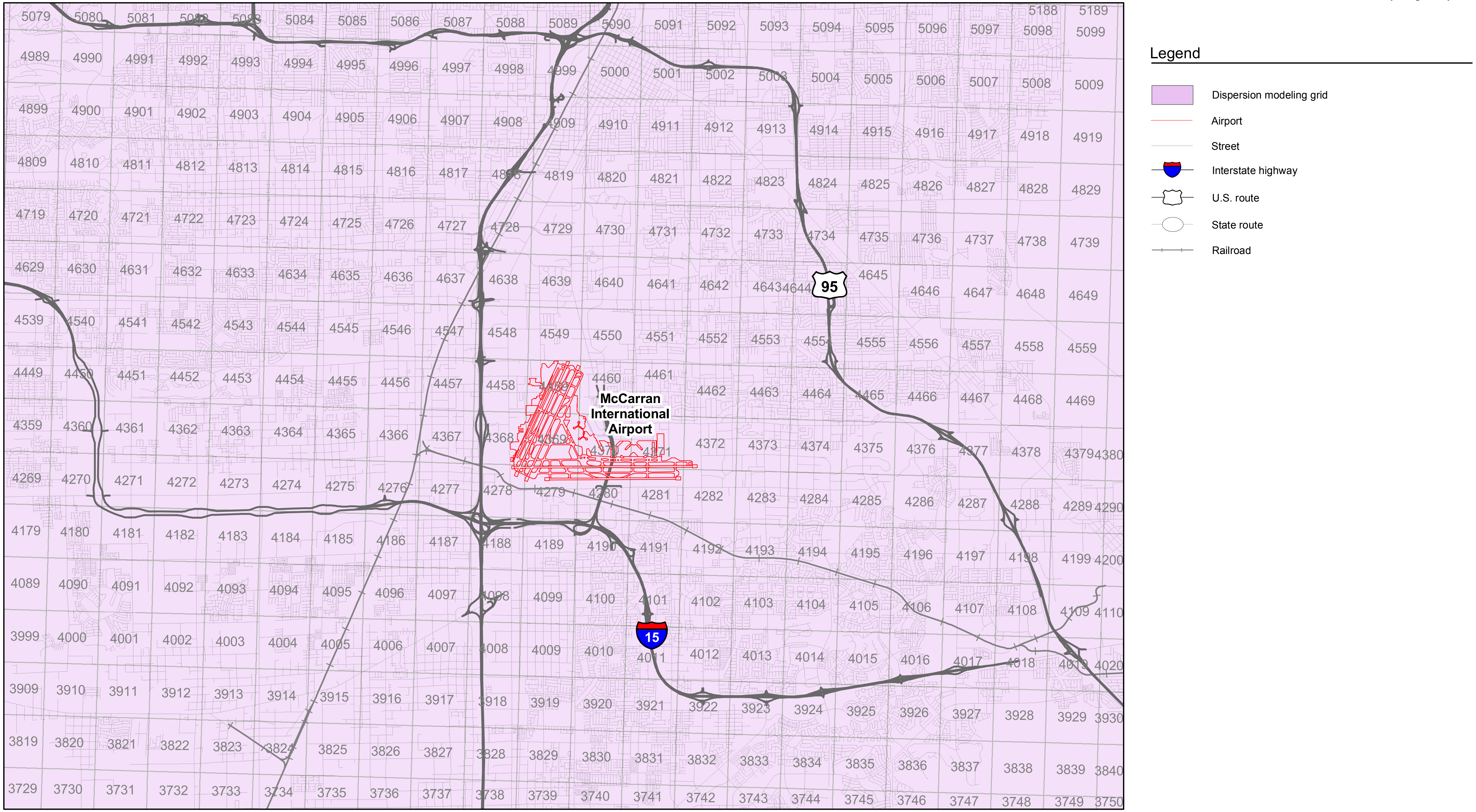
Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-8

Latitude/Longitude Coordinates for Point Sources, Ivanpah Airport

Emission Source	Category	CO	VOC	NO_X	SO_X	PM_{10}	$PM_{2.5}$	Latitude	Longitude
		Annual Emissions Estimate by Pollutant (Tons)							
Boiler 1	Boiler	16.881	1.106	10.046	0.119	1.528	1.528	28.211759940	115.481758009
Boiler 2	Boiler	16.881	1.106	10.046	0.119	1.528	1.528	28.212175180	115.481742819
Emergency Generators 1-13	Generator	4.557	0.637	10.303	0.331	0.578	0.578	28.084248093	115.493906496

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

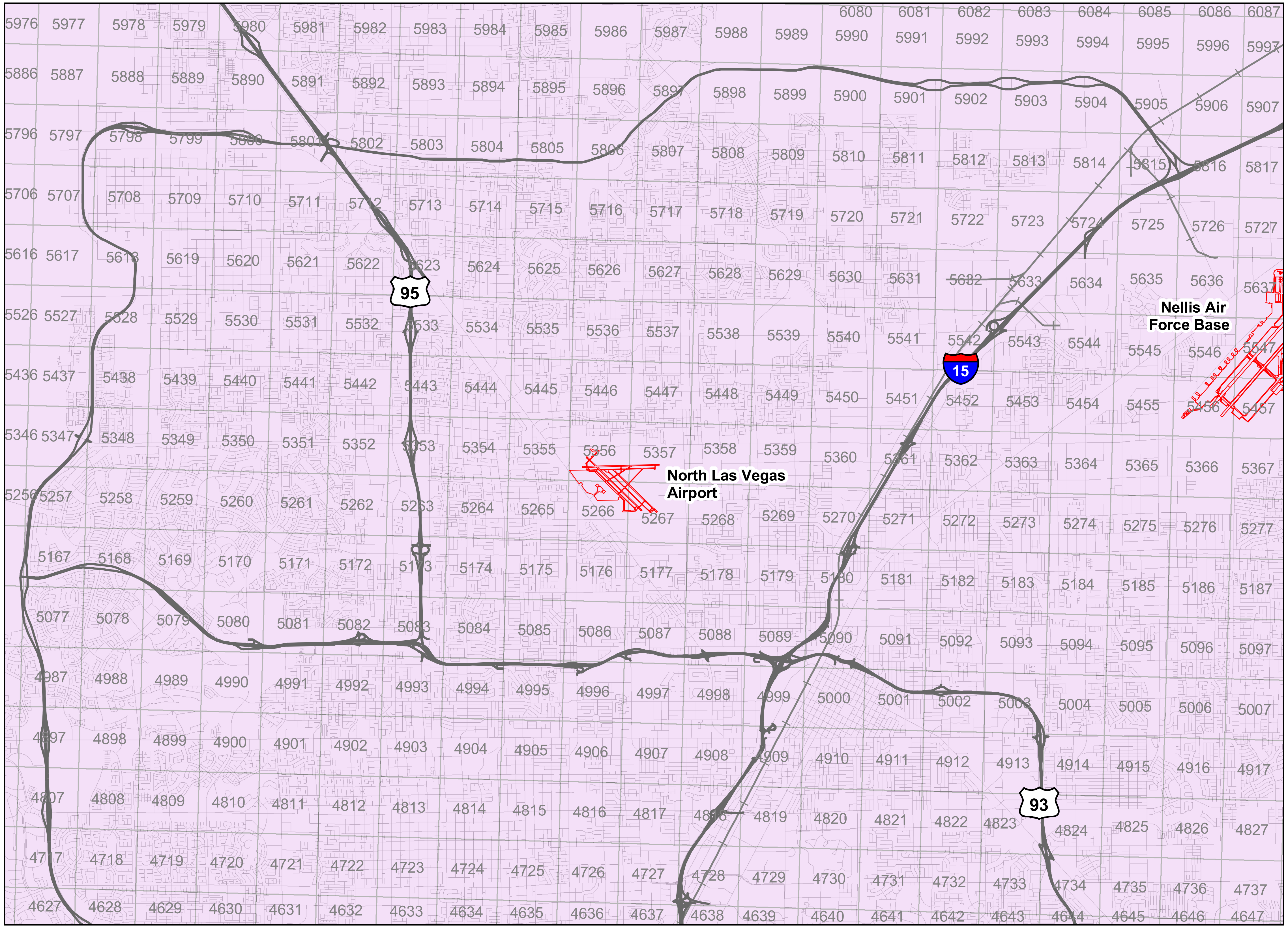


Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-1

north
0 1.5 miles

Dispersion Modeling Grids
McCarran International Airport



Legend

- Dispersion modeling grid
- Airport
- Street
- Interstate highway
- U.S. route
- State route
- Railroad

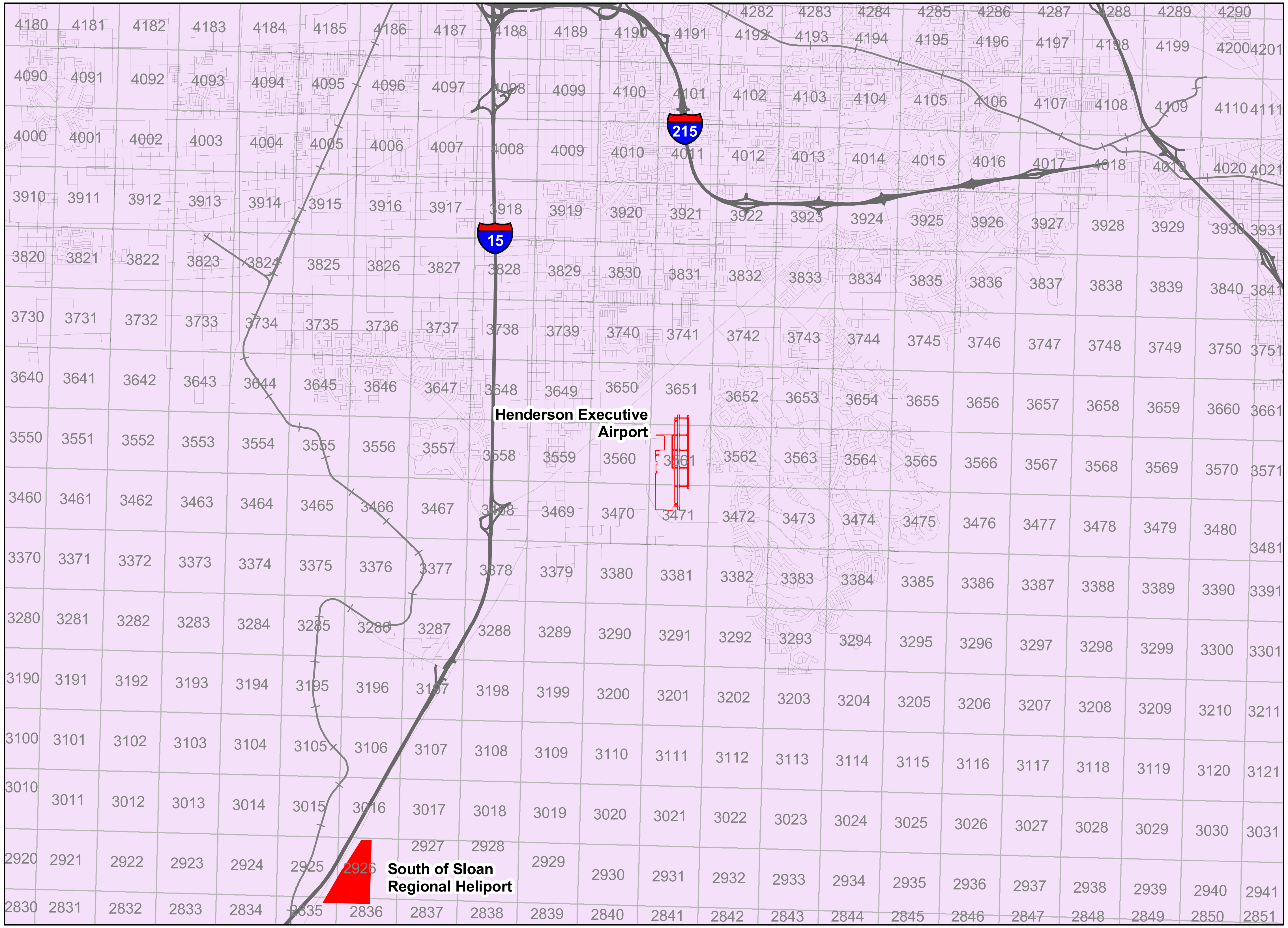
Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-2

north

0 1.5 miles

Dispersion Modeling Grids
North Las Vegas Airport



Legend

- Dispersion modeling grid
- Airport
- Street
- Interstate highway
- U.S. route
- State route
- Railroad

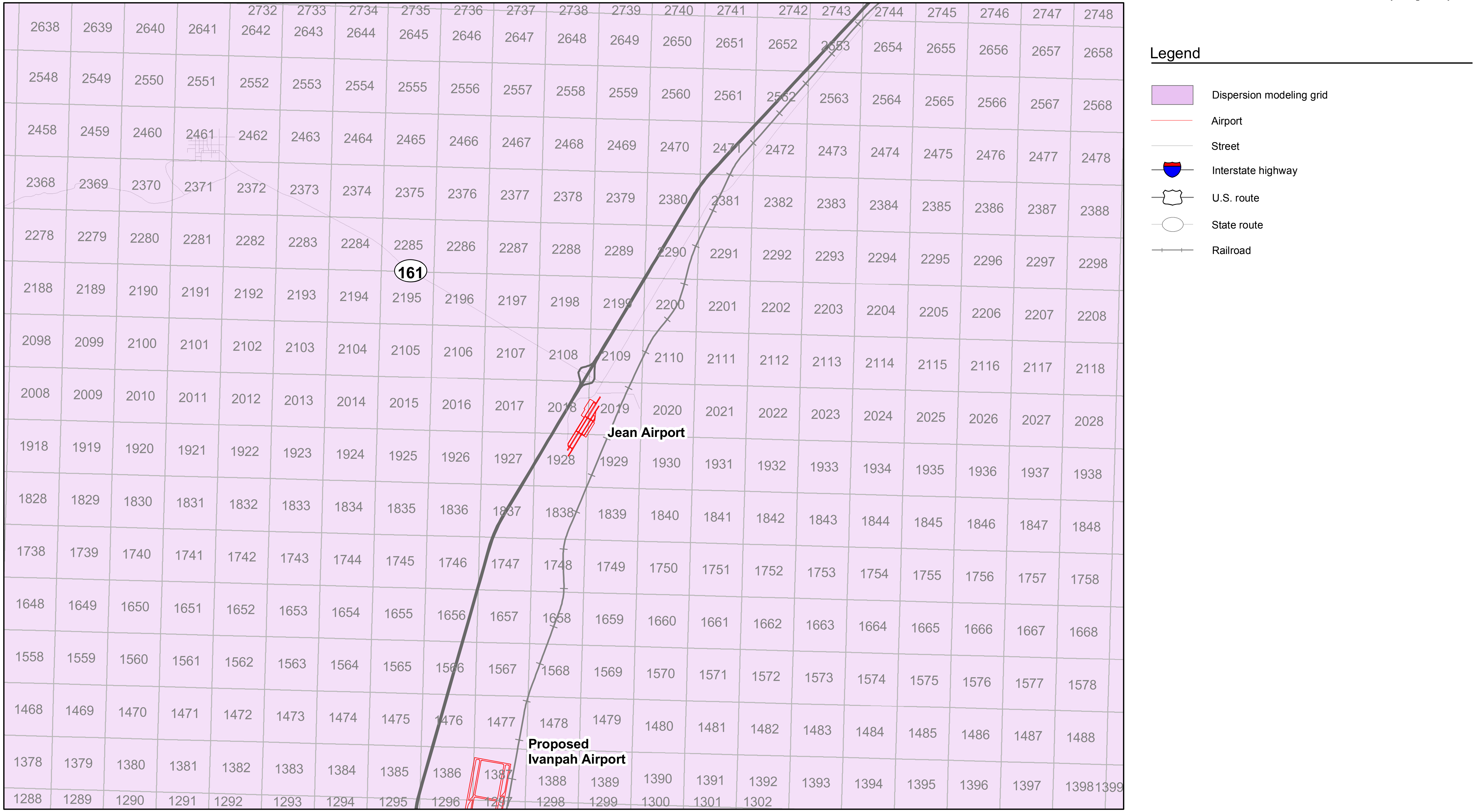
Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-3

north

0 1.5 miles

Dispersion Modeling Grids
Henderson Executive Airport

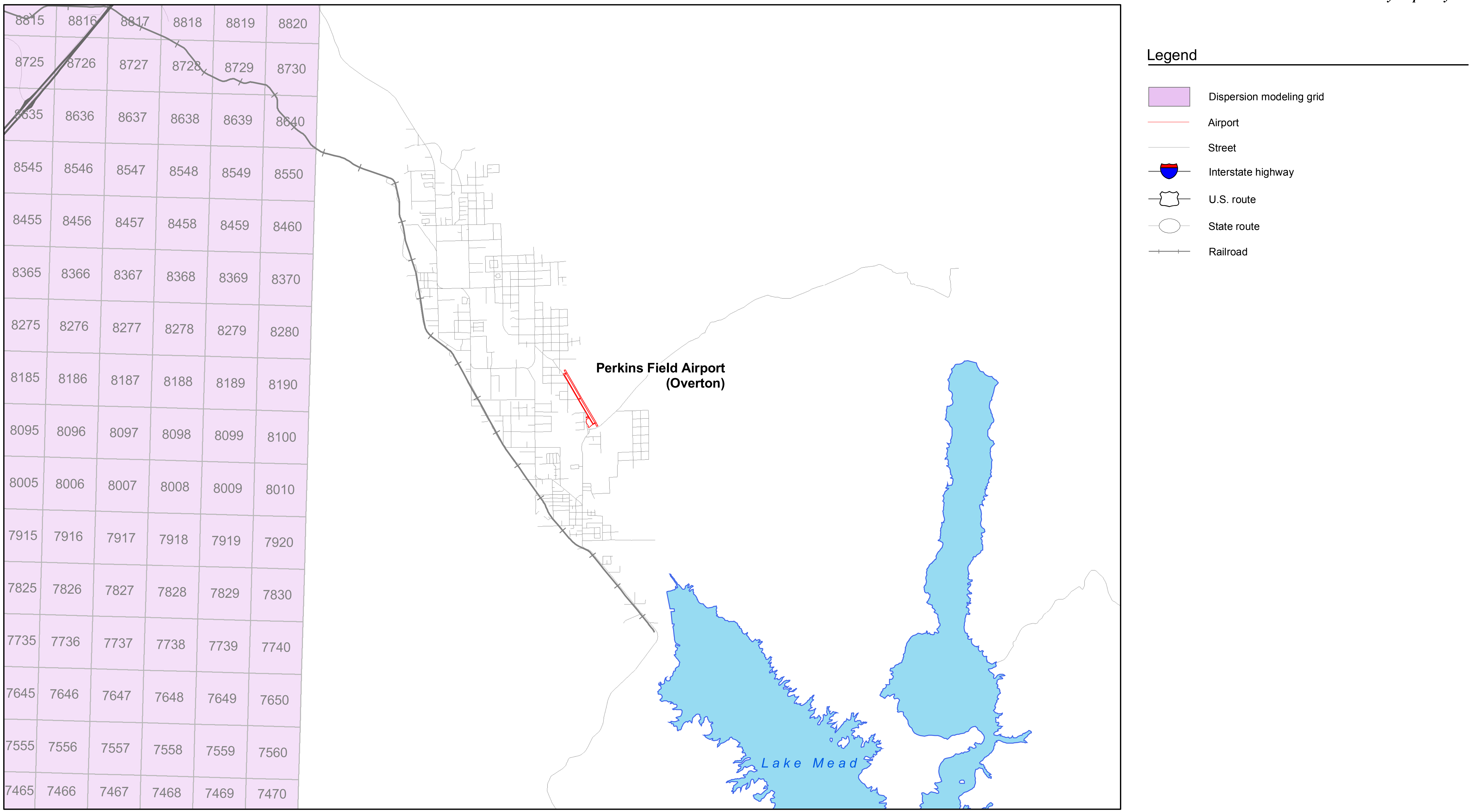


Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-4

north
0 1.5 miles

Dispersion Modeling Grids
Jean Airport

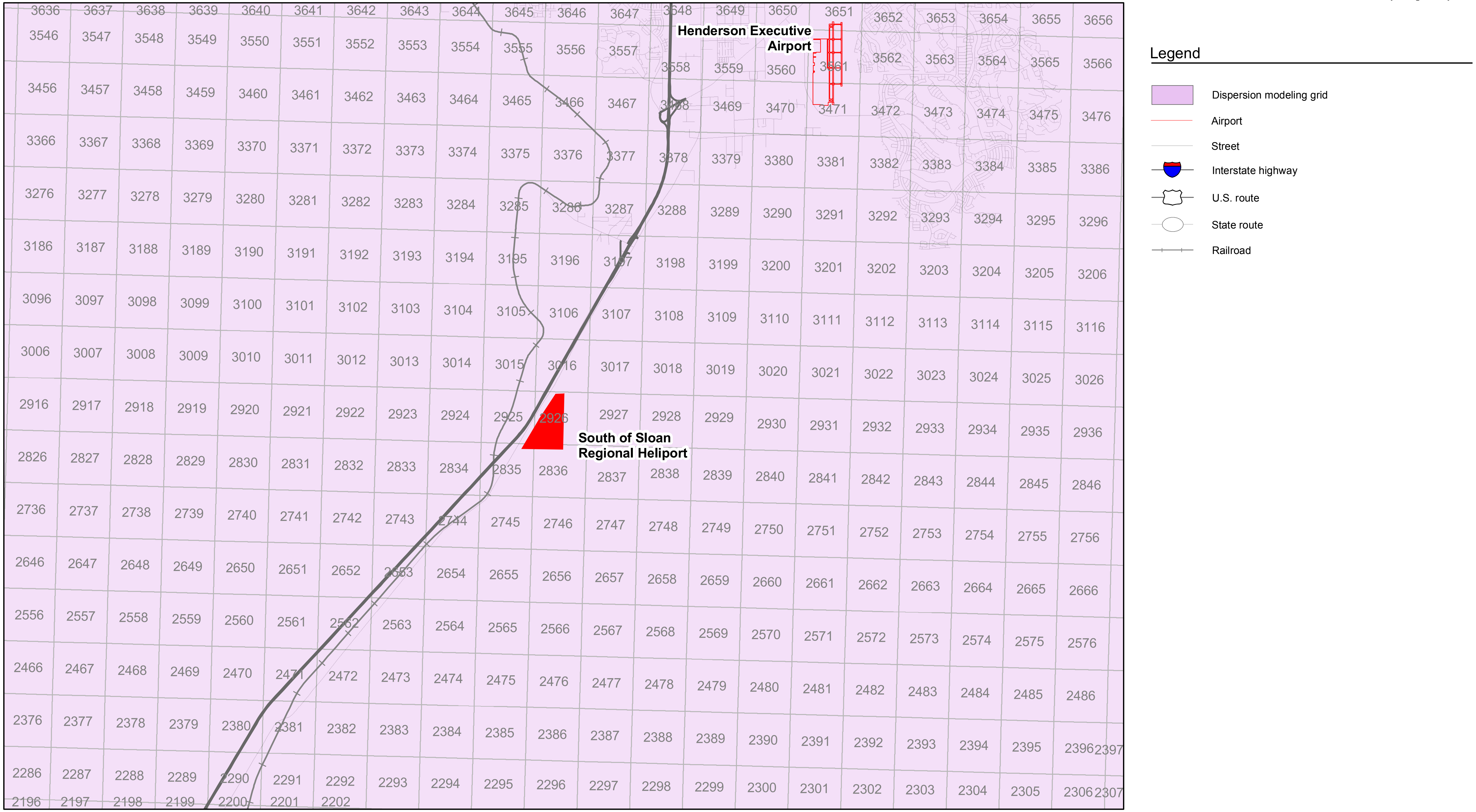


Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-5

north
0 1.5 miles

Dispersion Modeling Grids
Perkins Field Airport



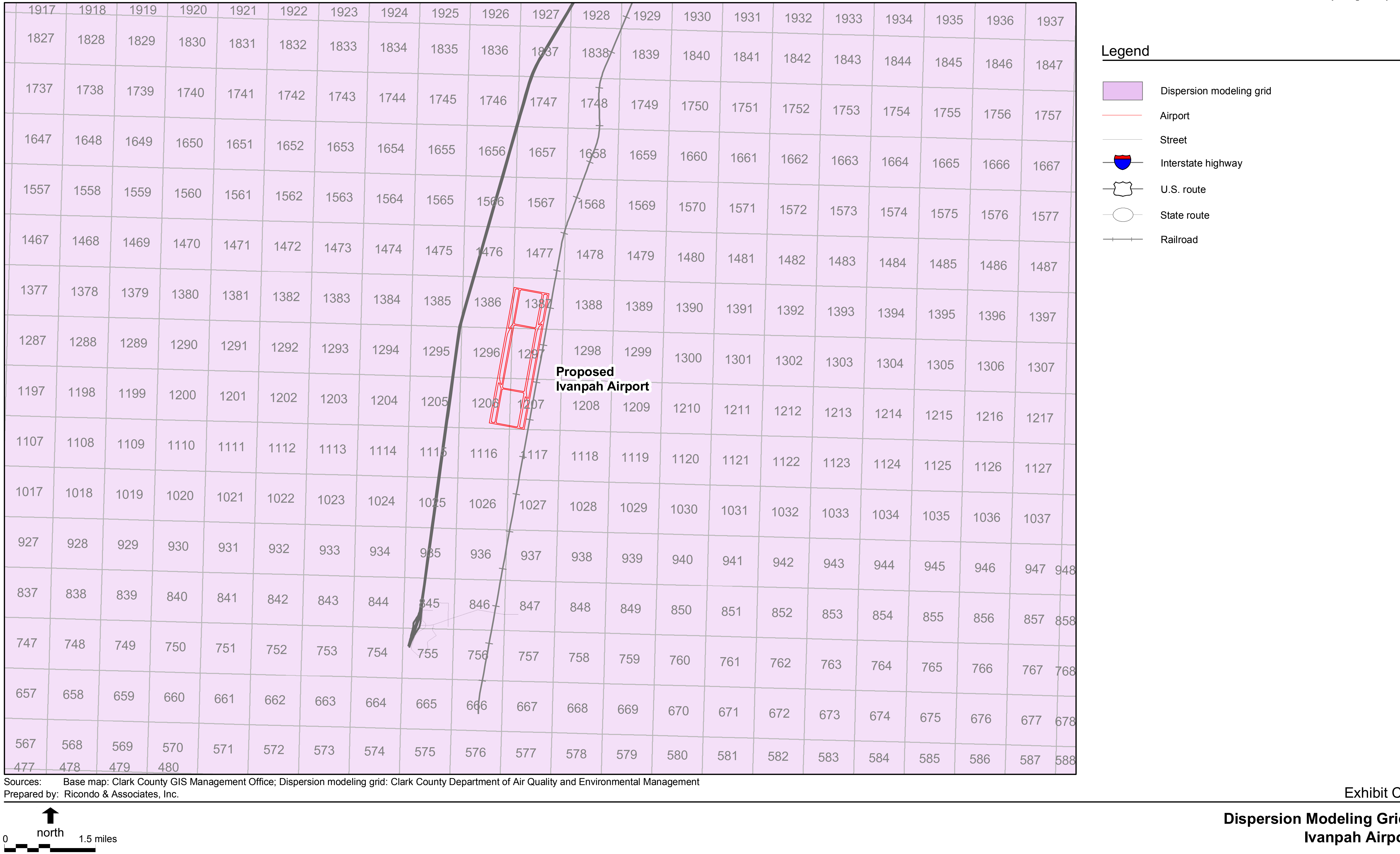
Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-6

north

0 1.5 miles

Dispersion Modeling Grids
South of Sloan Regional Heliport



Sources: Base map: Clark County GIS Management Office; Dispersion modeling grid: Clark County Department of Air Quality and Environmental Management
Prepared by: Ricondo & Associates, Inc.

Exhibit C-7

Dispersion Modeling Grids
Ivanpah Airport

Table C-9

Airport Emission Sources and Grid Cells for Regional Dispersion Modeling

Emission Source	Dispersion Modeling Grid Cells [1/]
McCarran International Airport	
Aircraft	4187, 4188, 4276, 4277, 4278, 4279, 4280, 4281, 4282, 4283, 4366, 4367, 4368, 4369, 4370, 4371, 4372, 4373, 4458, 4459, 4460, 4461, 4462, 4549, 4550, 4639, 4640
Auxiliary Power Unit	4459, 4369, 4370, and 4371
Ground Support Equipment	4459, 4369, 4370, and 4371
On-road Motor Vehicles	4460, 4370, and 4371
North Las Vegas Airport	
Aircraft	5177, 5178, 5265, 5266, 5267, 5268, 5355, 5356, 5357, 5358, 5445, 5446
Auxiliary Power Unit	5356 and 5266
Ground Support Equipment	5266
On-road Motor Vehicles	5266
Henderson Executive Airport	
Aircraft	3381, 3470, 3471, 3472, 3560, 3561, 3562, 3651, 3741
Auxiliary Power Unit	3561
Ground Support Equipment	3561 and 3471
On-road Motor Vehicles	3560 and 3561
Jean Airport	
Aircraft	1928, 1929, 2018, 2019, 2108, 2109
Ground Support Equipment	1928 and 2018
On-road Motor Vehicles	1928 and 2018
Perkins Field Airport [2/]	
Aircraft	Not applicable
Ground Support Equipment	Not applicable
On-road Motor Vehicles	Not applicable
South of Sloan Regional Heliport	
Helicopters	2835, 2836, 2837, 2925, 2926, 2927, 3015, 3016, 3017
Ground Support Equipment	2926
On-road Motor Vehicles	2926
Ivanpah Airport [3/]	
Aircraft	1026, 1027, 1116, 1117, 1206, 1207, 1296, 1297, 1386, 1387, 1476, 1477, 1567, 1568
Auxiliary Power Unit	1386,1296, and 1206
Ground Support Equipment	1386,1296, and 1206
On-road Motor Vehicles	1386,1296, and 1206

Notes:

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibits C-1 through C-7.

2/ Perkins Field Airport is located outside the 8-hour ozone nonattainment boundary.

3/ Dispersion modeling has been conducted for the proposed Ivanpah Airport. Dispersion modeling results are documented in MWH Americas, Inc., *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-10

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – McCarran International Airport

Emission Source	Dispersion Modeling Grid Cell [1/]	Latitude	Longitude
Aircraft	4187	36.05938045	115.1912752
	4188	36.05900668	115.1764266
	4276	36.07180963	115.2056673
	4277	36.07143777	115.190816
	4278	36.07106394	115.175965
	4279	36.07068813	115.1611141
	4280	36.07031036	115.1462633
	4281	36.06993062	115.1314127
	4282	36.0695489	115.1165622
	4283	36.06916522	115.1017119
	4366	36.08386712	115.2052104
	4367	36.0834952	115.1903567
	4368	36.0831213	115.1755032
	4369	36.08274543	115.1606499
	4370	36.08236759	115.1457967
	4371	36.08198778	115.1309437
	4372	36.081606	115.1160908
	4373	36.08122225	115.1012381
	4458	36.09517877	115.1750414
	4459	36.09480283	115.1601856
	4460	36.09442493	115.14533
	4461	36.09404506	115.1304745
	4462	36.09366321	115.1156192
	4549	36.10686034	115.1597211
	4550	36.10648237	115.1448631
	4639	36.11891795	115.1592565
	4640	36.11853991	115.144396
Auxiliary Power Unit	4459	36.09480283	115.1601856
	4369	36.08274543	115.1606499
	4370	36.08236759	115.1457967
	4371	36.08198778	115.1309437
Ground Support Equipment	4459	36.09480283	115.1601856
	4369	36.08274543	115.1606499
	4370	36.08236759	115.1457967
	4371	36.08198778	115.1309437
On-road Motor Vehicles	4460	36.09442493	115.14533
	4370	36.08236759	115.1457967
	4371	36.08198778	115.1309437

Note:
1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-1.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-11

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – North Las Vegas Airport

Emission Source	Dispersion Modeling Grid Cells [1/]	Latitude	Longitude
Aircraft	5177	36.19201664	115.1862161
	5178	36.19164216	115.1713408
	5265	36.20481823	115.2155113
	5266	36.20444764	115.2006333
	5267	36.20407507	115.1857553
	5268	36.20370053	115.1708775
	5355	36.2168769	115.2150552
	5356	36.21650624	115.2001747
	5357	36.21613361	115.1852944
	5358	36.215759	115.1704141
	5445	36.22893566	115.214599
	5446	36.22856494	115.199716
Auxiliary Power Unit	5356	36.21650624	115.2001747
	5266	36.20444764	115.2006333
Ground Support Equipment	5266	36.20444764	115.2006333
On-road Motor Vehicles	5266	36.20444764	115.2006333

Note:

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-2.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-12

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – Henderson Executive Airport

Emission Source	Dispersion Modeling Grid Cells 1/	Latitude	Longitude
Aircraft	3381	35.94936473	115.1360944
	3470	35.96179999	115.1504557
	3471	35.96142084	115.1356269
	3472	35.96103972	115.1207983
	3560	35.97385627	115.1499905
	3561	35.97347705	115.1351593
	3562	35.97309586	115.1203282
	3651	35.98553338	115.1346915
	3741	35.99758981	115.1342236
Auxiliary Power Unit	3561	35.97347705	115.1351593
Ground Support Equipment	3561	35.97347705	115.1351593
	3471	35.96142084	115.1356269
On-road Motor Vehicles	3560	35.97385627	115.1499905
	3561	35.97347705	115.1351593

Note:

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-3.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-13

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – Jean Airport

Emission Source	Dispersion Modeling Grid Cells [1/]	Latitude	Longitude
Aircraft			
	1928	35.76124378	115.3358069
	1929	35.76088928	115.3210173
	2018	35.77329891	115.3353731
	2019	35.77294434	115.3205811
	2108	35.78535415	115.3349392
	2109	35.78499952	115.3201448
Ground Support Equipment	1928	35.76124378	115.3358069
	2018	35.77329891	115.3353731
On-road Motor Vehicles	1928	35.76124378	115.3358069
	2018	35.77329891	115.3353731

Note:

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-4.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-14

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – South of Sloan Regional Heliport

Emission Source	Dispersion Modeling Grid Cells [1/]	Latitude	Longitude
Aircraft	2835	35.87927311	115.2277699
	2836	35.87890424	115.2129572
	2837	35.8785334	115.1981447
	2925	35.89132895	115.2273178
	2926	35.89096001	115.2125027
	2927	35.89058911	115.1976878
	3015	35.90338489	115.2268655
	3016	35.90301589	115.2120481
	3017	35.90264492	115.1972307
Ground Support Equipment	2926	35.89096001	115.2125027
On-road Motor Vehicles	2926	35.89096001	115.2125027

Note:

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-6.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

Table C-15

Airport Emission Sources and Coordinates for Dispersion Modeling Grid Cells – Ivanpah Airport

Emission Source	Dispersion Modeling Grid Cells [1/]	Latitude	Longitude
Aircraft	1026	35.641401	115.3696686
	1027	35.64105102	115.3549028
	1116	35.65345505	115.369241
	1117	35.65310501	115.3544728
	1206	35.66550922	115.3688133
	1207	35.66515912	115.3540427
	1296	35.67756351	115.3683855
	1297	35.67721335	115.3536124
	1386	35.68961792	115.3679575
	1387	35.6892677	115.353182
	1476	35.70167246	115.3675293
	1477	35.70132218	115.3527515
	1567	35.71337677	115.3523208
	1568	35.71302447	115.3375406
Auxiliary Power Unit	1386	35.68961792	115.3679575
	1296	35.67756351	115.3683855
	1206	35.66550922	115.3688133
Ground Support Equipment	1386	35.68961792	115.3679575
	1296	35.67756351	115.3683855
	1206	35.66550922	115.3688133
On-road Motor Vehicles	1386	35.68961792	115.3679575
	1296	35.67756351	115.3683855
	1206	35.66550922	115.3688133

Notes:
Dispersion modeling has been conducted for the proposed Ivanpah Airport. Dispersion modeling results are documented in MWH Americas, Inc., *Final Air Quality Modeling Analysis of the Proposed Ivanpah Valley Airport*, July 22, 2005.

1/ Grid cells defined by the Clark County Department of Air Quality and Environmental Management are depicted on Exhibit C-7.

Source: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

APPENDIX E

Clark County Vertically Distributed Aircraft Emission Inventory Report

Clark County
Department of Aviation

Vertically Distributed Aircraft Emissions Inventories for McCarran International Airport and the Proposed Ivanpah Airport For Inclusion in the Ozone State Implementation Plan for Clark County, Nevada

October 16, 2006

Prepared for:

Clark County Department of Aviation
McCarran International Airport
P.O. Box 11005
Las Vegas, NV 89111-1005

Prepared by:

CDM
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Irvine, California 92612

Project No. 45366-54285-AQPLG

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Section 1
Introduction

1.1 Background

The Clark County Department of Air Quality and Environmental Management (DAQEM) had requested inventories of emissions from stationary and mobile sources (on-road and nonroad) at the airports in the Clark County Airport System for inclusion in the new State Implementation Plan (SIP) for ozone. The emissions from five existing airports, one proposed heliport, and one proposed commercial airport[1] were provided by the Clark County Department of Airports (CCDOA) in the Ricondo & Associates (Ricondo) May 2006 report titled "Emissions Inventories for Clark County Airport System Airports For Inclusion in the Ozone State Implementation Plan for Clark County, Nevada" (Ricondo 2006a). Air pollutant emissions were inventoried for two historical years: 2002 and 2003. Air pollutant emissions inventories were also developed for three future years: 2008, 2013, and 2018. The aircraft, auxiliary power unit (APU), and ground support equipment (GSE) emissions were developed using the Emissions and Dispersion Modeling Systems (EDMS) developed by the Federal Aviation Administration (FAA).

It is noted that the Heliport would not be operational until 2009; therefore, emissions inventories were not prepared for the Heliport for 2002, 2003, or 2008. The Ivanpah Airport (IVP) would not be operational until 2017; therefore, emissions inventories were not prepared for that airport for 2002, 2003, 2008, or 2013.

DAQEM had also requested that these airport emissions be distributed into the appropriate Community Multi-scale Air Quality (CMAQ) model grid cells used in the ozone SIP attainment demonstration analyses. The CMAQ grid cell system was provided by DAQEM to Ricondo; and Appendix C of the Ricondo report (Ricondo 2006a) provided listings of appropriate grid cells for each mobile source type (aircraft, APU, GSE, and on-road vehicles) at each airport/heliport, including the grid cell center coordinates in decimal latitude and longitude. In addition, the report provided decimal latitude and longitude coordinates for each stationary source located at each airport/heliport (Ricondo 2006a).

As noted in the Ricondo emissions inventories, IVP has not yet secured all necessary approvals and is undergoing environmental review by the Federal Aviation Administration (FAA) and Bureau of Land Management (BLM) pursuant to the National Environmental Policy Act, Clean Air Act conformity regulations and other provisions. The emissions estimates associated with the Ivanpah Airport are preliminary, conservative estimates of the future airport's emissions for air-quality

[1] Existing airports are McCarran International (LAS), North Las Vegas (VGT), Henderson Executive (HND), Jean (0L7), and Perkins Field (U08). The proposed heliport is referred to as the South of Sloan Regional Heliport. The proposed commercial airport is referred to as the Ivanpah Airport (IVP) in this document; however, it is also referred to as the Southern Nevada Supplemental Airport elsewhere.

planning purposes. FAA, BLM and the CCDOA will continue to develop more refined estimates of airport-related emissions associated with the proposed Airport.

1.2 Emission Elevations Above the Ground

The Environmental Protection Agency's (EPA's) CMAQ model includes state-of-the-science capabilities for conducting urban to regional scale simulations of multiple air quality issues, including tropospheric ozone, fine particles, toxics, acid deposition, and visibility degradation (EPA 1999). The model uses grid cells of various resolutions (sizes) to predict the dispersion and chemical reaction products of air pollutant emissions in the atmosphere. These cells can be distributed horizontally across a region and layered vertically above the ground surface.

The aircraft emissions at McCarran International Airport (LAS) are presented in the Ricondo report for two ambient mixing heights: 3,000 feet and 6,535 feet (Ricondo 2006a). A mixing height typically represents the height of a temperature inversion layer that prevents pollutants emitted below the inversion from dispersing any higher, trapping those pollutants between the ground and the mixing height. Pollutants emitted above the mixing height (from aircraft at cruising altitudes, for example) typically do not penetrate the inversion layer, thus usually have no impact on ground level pollutant concentrations. The 3,000 ft mixing height is the default value included in EDMS. For airport analyses, the higher the mixing height the more emissions associated with aircraft are below the inversion layer. The higher mixing height used for LAS is based on DAQEM's estimate of the appropriate mixing height in the Las Vegas Valley.

Similarly, the aircraft emissions at the proposed IVP are presented in the Ricondo 2006 report for mixing heights of 3,000 feet and 7,875 feet (Ricondo 2006a). The latter represents the DAQEM's estimate of the appropriate mixing height in the Ivanpah Valley, and is similar to values presented elsewhere (Holzworth 1972).

Initially, DAQEM had intended to include all of the airports' emissions in the lowest vertical layer of CMAQ grid cells. However, a large portion of ozone-forming emissions from aircraft - approaching 50 percent of total airport emissions at the LAS and IVP - occur 1,000 feet or more above the ground surface. These two airports have the highest emissions of ozone-forming oxides of nitrogen (NOx) and volatile organic compounds (VOC) of the county's airports. Therefore, DAQEM has requested that aircraft emissions from LAS and IVP be distributed both horizontally and vertically (up to the appropriate mixing height) to more accurately model airport emissions. This report provides the distributed emissions for aircraft at these two airports.

Section 2
Aircraft Emissions

2.1 Emissions by Operating Mode

Aircraft emissions for LAS and IVP were estimated by Ricondo using EDMS developed by the FAA. The EDMS model estimates aircraft emissions by operating mode (FAA 2005). The operating modes and associated heights above ground addressed in EDMS include:

- Taxi/Idle –occurs on the ground as aircraft taxi from the gate to the runway for takeoff, from the runway to the gate after landing, and any time when the aircraft is idling (e.g., waiting to cross an active runway or waiting in the departure queue to takeoff).

- Takeoff – occurs along the runway beginning on the ground as the aircraft starts its takeoff roll and continues until the aircraft is 1,000 feet above the ground.

- Climbout – begins at 1,000 feet above the ground during an aircraft departure and continues up to the mixing height.

- Approach – begins at the mixing height and continues down the runway surface during an aircraft arrival.

Because the climbout and approach emissions are directly proportional to the mixing height, higher mixing heights result in higher aircraft emissions occurring below the inversion layer. Ricondo provided the model output files to CDM for use in determining the aircraft emissions by operating mode (Ricondo 2006b, 2006c).

2.1.1 LAS Emissions

The LAS emissions for 2002, 2003, 2008, 2013, and 2018 are summarized in the Ricondo report by general source category: aircraft, APU, GSE, on-road vehicles, and stationary sources (Ricondo 2006a). The higher mixing height (6,535 feet) is used in this distribution since it results in the more conservative (greater) aircraft emissions in the region. The aircraft emissions for each operating mode at LAS are presented in Tables 2-1 through 2-5 for 2002, 2003, 2008, 2013, and 2018, respectively.

2.1.2 IVP Emissions

Similar to LAS, the Ricondo report provided emission summaries for IVP in 2018 by source category (Ricondo 2006a). The Ivanpah Valley summer afternoon mixing height, 7,875 feet is used in this distribution. The aircraft emissions by operating mode at IVP in 2018 are presented in Table 2-6.

Table 2-1
Las Vegas McCarran International Airport 2002 Aircraft Emissions by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	639.323	31.794	617.296	70.099	16.172	16.172
Climb Out	513.694	11.978	1,333.748	65.657	15.697	15.697
Takeoff	128.345	4.261	708.993	28.595	7.370	7.370
Idle	1,604.088	180.077	236.037	58.508	10.077	10.077
Aircraft sub	**2,885.450**	**228.110**	**2,896.073**	**222.859**	**49.316**	**49.316**

Sources: CDM 2006; Ricondo 2006c.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-2
Las Vegas McCarran International Airport 2003 Aircraft Emissions by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	844.588	30.315	575.112	64.984	17.471	17.471
Climb Out	732.432	12.508	1,121.587	55.020	16.370	16.370
Takeoff	177.670	3.727	598.905	24.130	8.104	8.104
Idle	1,518.234	149.390	224.047	54.259	10.666	10.666
Aircraft sub	**3,272.924**	**195.940**	**2,519.651**	**198.393**	**52.612**	**52.612**

Sources: CDM 2006; Ricondo 2006c.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-3
Las Vegas McCarran International Airport 2008 Aircraft Emissions by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	615.153	25.298	729.306	80.282	17.885	17.885
Climb Out	450.506	10.124	1,433.709	68.801	16.455	16.455
Takeoff	112.244	3.399	761.213	30.058	7.584	7.584
Idle	1,874.692	167.337	328.010	77.116	12.499	12.499
Aircraft sub	**3,052.594**	**206.158**	**3,252.238**	**256.256**	**54.423**	**54.423**

Sources: CDM 2006; Ricondo 2006c.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-4
Las Vegas McCarran International Airport 2013 Aircraft Emissions
by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	638.555	23.305	834.658	90.094	16.269	16.269
Climb Out	467.447	10.183	1,648.315	77.489	14.698	14.698
Takeoff	117.560	3.467	872.078	33.851	7.127	7.127
Idle	2,054.805	176.054	369.841	85.557	12.514	12.514
Aircraft sub	**3,278.367**	**213.008**	**3,724.893**	**286.992**	**50.609**	**50.609**

Sources: CDM 2006; Ricondo 2006c.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-5
Las Vegas McCarran International Airport 2018 Aircraft Emissions
by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	656.281	23.709	930.738	99.152	17.281	17.281
Climb Out	467.041	10.588	1,853.698	86.073	15.646	15.646
Takeoff	118.022	3.683	977.333	37.528	7.531	7.531
Idle	2,624.823	222.079	481.064	110.545	15.670	15.670
Aircraft sub	**3,866.167**	**260.059**	**4,242.833**	**333.298**	**56.128**	**56.128**

Sources: CDM 2006; Ricondo 2006c.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-6
Ivanpah Airport 2018 Aircraft Emissions
by Operating Mode and by Aircraft Type

MODE	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
Approach	300.153	12.913	775.007	81.026	8.029	8.029
Climb Out	105.037	8.327	1,949.132	83.480	10.010	10.010
Takeoff	27.950	2.372	790.494	28.249	3.417	3.417
Idle	1,688.166	138.516	336.067	78.074	7.594	7.594
Aircraft sub	**2,121.306**	**162.128**	**3,850.700**	**270.828**	**29.050**	**29.050**

Sources: CDM 2006; Ricondo 2006b.
Note: Mixing Height for IVP assumed to be 7,875 ft AGL, per Ricondo 2006a.

2.2 Emissions by Arrival and Departure Direction

The climbout and approach emissions identified for each airport and year in Section 2.1 can be further split between runway pairs and flow direction.

2.2.1 LAS Approach and Climbout Emissions by Runway

Actual runway use in 2004 and predicted runway use in 2011 and 2017 at LAS were provided by Ricondo (2006d) for arrivals and departures. The individual runway use for each year are presented in Table 2-7. The approach and climbout emissions at LAS in 2002 and 2003 were assigned to individual runways based on the 2004 actual usage; the emissions in 2008 and 2013 were assigned to runways based on the 2011 usage estimate; and the emissions in 2018 were assigned based on the 2017 usage estimate. The approach emissions by runway for each year are summarized in Table 2-8, and the climbout emissions by runway are summarized in Table 2-9. The activity and emissions for set of parallel runways (25L and 25R for example) are combined since a single CMAQ grid cell (1.3 km x 1.3 km) typically covers both runways.

2.2.2 IVP Approach and Climbout Emissions by Runway

The proposed IVP would have a generally north-south runway orientation. An estimate of the amount of time spent in north flow versus south flow was provided by Ricondo (2006e), based on weather and operations at LAS. Based on this information, it is estimated that **north flow will occur 17.6 percent** of the time, and **south flow will occur 82.4 percent** of the time at IVP. Approach and climbout emissions by flow direction for IVP in 2018 are presented in Table 2-10.

Table 2-7
Actual and Predicted Runway Use at Las Vegas McCarran International Airport

Year	Runway								Grand Total
	01L	01R	07L	07R	19L	19R	25L	25R	
2004									
% Arrival	7.67	4.68	0.10	1.54	8.70	14.38	61.09	1.84	100.00
% Departure	2.90	9.09	7.20	0.17	22.63	6.73	0.80	50.48	100.00
2011									
% Arrival	9.46	5.89	0.16	1.84	9.74	12.96	58.20	1.76	100.00
% Departure	3.31	11.84	11.42	0.17	20.34	5.54	0.74	46.64	100.00
2017									
% Arrival	10.95	6.91	0.15	2.14	10.67	12.02	55.39	1.77	100.00
% Departure	3.48	13.98	15.04	0.23	18.48	4.78	0.71	43.30	100.00

Source: Ricondo 2006d.

Table 2-8
Las Vegas McCarran International Airport - Aircraft Approach Emissions by Runway and Year

Year and Runway	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
2002						
1L/R	78.956	3.927	76.236	8.657	1.997	1.997
19L/R	147.556	7.338	142.472	16.179	3.732	3.732
7L/R	10.485	0.521	10.124	1.150	0.265	0.265
25L/R	402.326	20.008	388.464	44.113	10.177	10.177
2002 Approach Total	**639.323**	**31.794**	**617.296**	**70.099**	**16.171**	**16.171**
2003						
1L/R	104.307	3.744	71.026	8.026	2.158	2.158
19L/R	194.931	6.997	132.736	14.998	4.032	4.032
7L/R	13.851	0.497	9.432	1.066	0.287	0.287
25L/R	531.499	19.077	361.918	40.894	10.995	10.995
2003 Approach Total	**844.588**	**30.315**	**575.112**	**64.984**	**17.472**	**17.472**
2008						
1L/R	94.426	3.883	111.948	12.323	2.745	2.745
19L/R	139.640	5.743	165.552	18.224	4.060	4.060
7L/R	12.303	0.506	14.586	1.606	0.358	0.358
25L/R	368.784	15.166	437.219	48.129	10.722	10.722
2008 Approach Total	**615.153**	**25.298**	**729.305**	**80.282**	**17.885**	**17.885**
2013						
1L/R	98.018	3.577	128.120	13.829	2.497	2.497
19L/R	144.952	5.290	189.467	20.451	3.693	3.693
7L/R	12.771	0.466	16.693	1.802	0.325	0.325
25L/R	382.814	13.971	500.377	54.011	9.753	9.753
2013 Approach Total	**638.555**	**23.304**	**834.657**	**90.093**	**16.268**	**16.268**
2018						
1L/R	117.212	4.234	166.230	17.709	3.086	3.086
19L/R	148.910	5.380	211.184	22.498	3.921	3.921
7L/R	15.029	0.543	21.314	2.271	0.396	0.396
25L/R	375.130	13.552	532.010	56.675	9.878	9.878
2018 Approach Total	**656.281**	**23.709**	**930.738**	**99.153**	**17.281**	**17.281**

Sources: CDM 2006.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-9
Las Vegas McCarran International Airport - Aircraft Climbout Emissions by Runway and Year

Year and Runway	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
2002						
1L/R	61.592	1.436	159.917	7.872	1.882	1.882
19L/R	150.821	3.517	391.588	19.277	4.609	4.609
7L/R	37.859	0.883	98.297	4.839	1.157	1.157
25L/R	263.422	6.142	683.946	33.669	8.049	8.049
2002 Climbout Total	**513.694**	**11.978**	**1,333.748**	**65.657**	**15.697**	**15.697**
2003						
1L/R	87.819	1.500	134.479	6.597	1.963	1.963
19L/R	215.042	3.672	329.298	16.154	4.806	4.806
7L/R	53.980	0.922	82.661	4.055	1.206	1.206
25L/R	375.591	6.414	575.150	28.214	8.395	8.395
2003 Climbout Total	**732.432**	**12.508**	**1121.588**	**55.020**	**16.370**	**16.370**
2008						
1L/R	68.252	1.534	217.207	10.423	2.493	2.493
19L/R	116.591	2.620	371.044	17.806	4.259	4.259
7L/R	75.044	1.686	238.822	11.461	2.741	2.741
25L/R	190.620	4.284	606.636	29.111	6.963	6.963
2008 Climbout Total	**450.507**	**10.124**	**1,433.709**	**68.801**	**16.456**	**16.456**
2013						
1L/R	70.818	1.543	249.720	11.740	2.227	2.227
19L/R	120.975	2.635	426.584	20.054	3.804	3.804
7L/R	77.866	1.696	274.570	12.908	2.448	2.448
25L/R	197.788	4.309	697.441	32.787	6.219	6.219
2013 Climbout Total	**467.447**	**10.183**	**1,648.315**	**77.489**	**14.698**	**14.698**
2018						
1L/R	81.546	1.849	323.656	15.028	2.732	2.732
19L/R	108.634	2.463	431.170	20.021	3.639	3.639
7L/R	103.823	2.354	412.077	19.134	3.478	3.478
25L/R	173.039	3.923	686.795	31.890	5.797	5.797
2018 Climbout Total	**467.042**	**10.589**	**1,853.698**	**86.073**	**15.646**	**15.646**

Sources: CDM 2006.
Note: Mixing Height for LAS assumed to be 6,535 ft AGL, per Ricondo 2006a.

Table 2-10
Proposed Ivanpah Airport - Aircraft Approach and Climbout Emissions by Flow Direction

Mode and Direction	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
2018 Approach						
North	52.827	2.273	136.401	14.261	1.413	1.413
South	247.326	10.641	638.606	66.765	6.616	6.616
2018 Approach Total	**300.153**	**12.914**	**775.007**	**81.026**	**8.029**	**8.029**
2018 Climbout						
North	18.487	1.466	343.047	14.693	1.762	1.762
South	86.551	6.861	1606.085	68.788	8.248	8.248
2018 Climbout Total	**105.038**	**8.327**	**1949.132**	**83.481**	**10.010**	**10.010**

Sources: CDM 2006.
Note: Mixing Height for IVP assumed to be 7,875 ft AGL, per Ricondo 2006a.

Section 3
Arrival and Departure Profiles

As noted in Section 2, climbout and approach emissions occur well above the ground. The EDMS model files include the climbout elevations above ground level relative to the distance from the end of the runway where the takeoff roll began, and approach elevations relative to the distance from the end of the runway where the aircraft will touch down. The climbout elevations are dependent on each aircraft's specifications and takeoff weight. The approach elevations in EDMS are assumed to be based on a standard 3 percent glide slope for all aircraft, except the Boeing 757 and 777.

Figure 3-1 presents the takeoff and climbout profiles for the aircraft types that are assumed to operate at LAS and IVP. The profiles are assumed to be straight paths since the data in EDMS does not provide sufficient information to develop non-straight profiles. Each aircraft has a different departure profile due to different engine climbout characteristics and aircraft weights. To simplify the analysis, the departure profiles were weighted by the number of operations of each aircraft type, and the operations-weighted profile was used to determine the elevation above ground level for climbout aircraft emissions. Attachment 1 to this memorandum presents the data excerpted from the EDMS DEPARTRS.DBF file, the aircraft-specific departure profiles, and the operations-weighted departure profile. The departure profiles for each aircraft in EDMS vary by takeoff weight. For this profile development, all aircraft were assumed to takeoff fully loaded (maximum takeoff weight or "Stage 1" in EDMS) which causes the aircraft to remain lower to the ground longer relative to takeoff with partially loaded aircraft.

Figure 3-2 presents the approach profile for all aircraft assumed to operate at LAS and IVP. As with the climbout profiles, the approach profiles were weighted by the number of operations of each aircraft type, and the operations-weighted approach profile was used for all aircraft. Attachment 2 to this memorandum presents the data excerpted from the EDMS ARRIVALS.DBF file, the aircraft-specific arrival profiles, and the operations-weighted arrival profile.

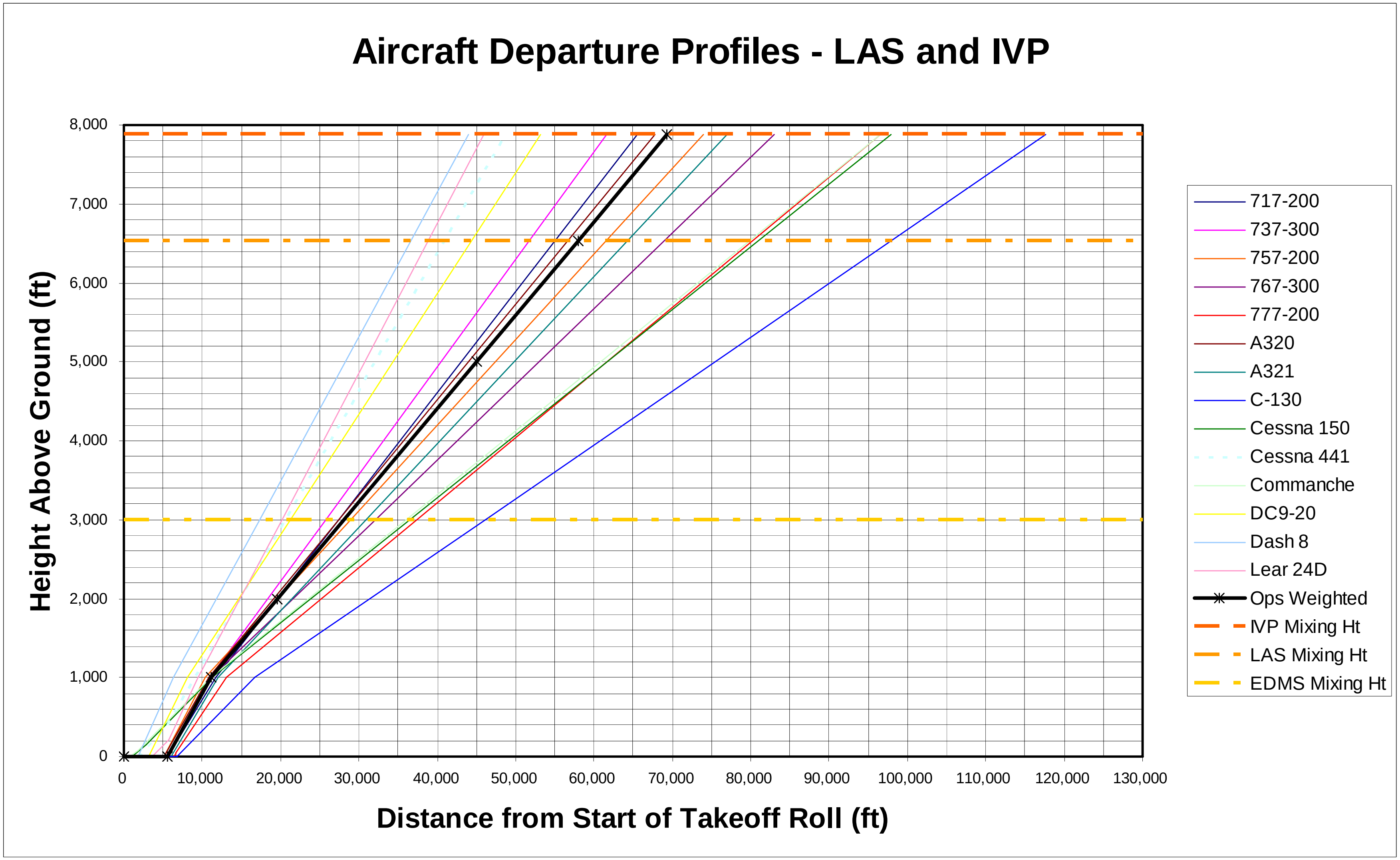
Aircraft Departure Profiles - LAS and IVP
Height Above Ground (ft)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
100,000
110,000
120,000
130,000
Distance from Start of Takeoff Roll (ft)
717-200
737-300
757-200
767-300
777-200
A320
A321
C-130
Cessna 150
Cessna 441
Commanche
DC9-20
Dash 8
Lear 24D
Ops Weighted
IVP Mixing Ht
LAS Mixing Ht
EDMS Mixing Ht

Figure 3-1

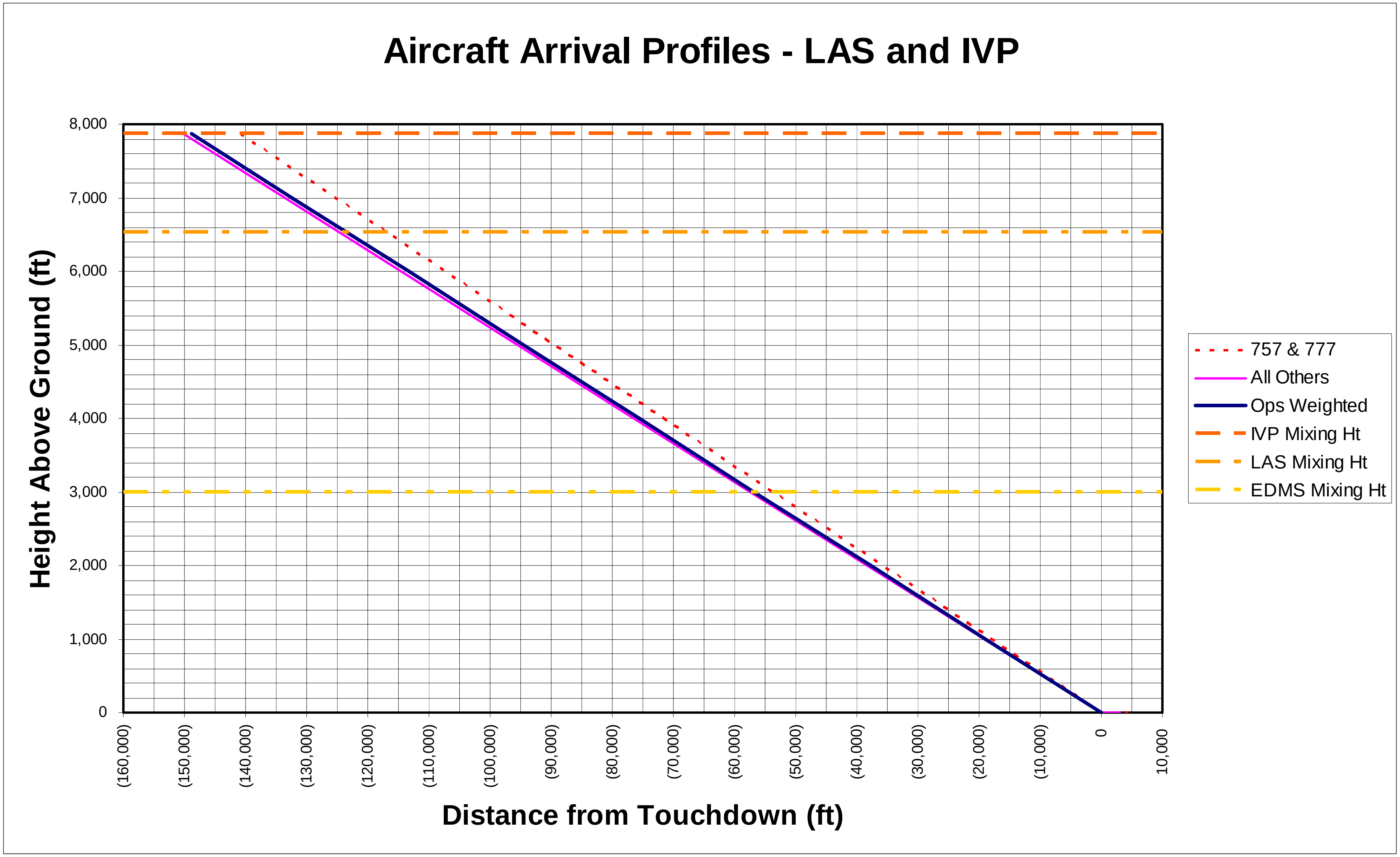
Aircraft Arrival Profiles - LAS and IVP
Height Above Ground (ft)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
(160,000)
(150,000)
(140,000)
(130,000)
(120,000)
(110,000)
(100,000)
(90,000)
(80,000)
(70,000)
(60,000)
(50,000)
(40,000)
(30,000)
(20,000)
(10,000)
0
10,000
Distance from Touchdown (ft)
757 & 777
All Others
Ops Weighted
IVP Mixing Ht
LAS Mixing Ht
EDMS Mixing Ht

Figure 3-2

Section 4
Approach and Climbout Emissions by Location and Elevation

Combining the profiles shown in Figures 3-1 and 3-2 with the approach and climbout emissions for each runway, and overlaying these results on the DAQEM CMAQ grid system for Clark County allowed the assignment of emissions to specific grid cells at a given elevations above ground level.

The results of this overlay for LAS approach emissions are presented in Tables 4-1A through 4-5D for 2002, 2003, 2008, 2013, and 2018, respectively. Similarly, the results for LAS climbout emissions are presented in Tables 4-6A through 4-10D, repectively. Finally, the 2018 IVP approach emissions are presented in Tables 4-11A and 4-11B, and 2018 IVP climbout emissions are presented in Table 4-12A and 4-12B. These tables present the DAQEM CMAQ grid cell number, emissions assigned to each cell, and the appropriate elevation for the emissions in feet above ground level.

This information was originally submitted to DAQEM on August 31, 2006 (CDM 2006a, 2006b). Each CMAQ grid cell decimal latitude and longitude were provided by Ricondo (2006f).

Table 4-1A
2002 LAS Aircraft Approach Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1926	6508	0.647	0.032	0.625	0.071	0.016	0.016
2016	6356	3.031	0.151	2.926	0.332	0.077	0.077
2107	6105	3.031	0.151	2.926	0.332	0.077	0.077
2197	5854	3.031	0.151	2.926	0.332	0.077	0.077
2288	5604	3.031	0.151	2.926	0.332	0.077	0.077
2378	5353	3.031	0.151	2.926	0.332	0.077	0.077
2468	5212	0.379	0.019	0.366	0.042	0.010	0.010
2469	5086	2.652	0.132	2.560	0.291	0.067	0.067
2559	4851	3.031	0.151	2.926	0.332	0.077	0.077
2649	4705	0.505	0.025	0.488	0.055	0.013	0.013
2650	4579	2.525	0.126	2.438	0.277	0.064	0.064
2740	4349	3.031	0.151	2.926	0.332	0.077	0.077
2830	4193	0.758	0.038	0.732	0.083	0.019	0.019
2831	4067	2.273	0.113	2.195	0.249	0.057	0.057
2921	3848	3.031	0.151	2.926	0.332	0.077	0.077
3011	3675	1.136	0.057	1.097	0.125	0.029	0.029
3012	3550	1.894	0.094	1.829	0.208	0.048	0.048
3102	3346	3.031	0.151	2.926	0.332	0.077	0.077
3192	3158	1.515	0.075	1.463	0.166	0.038	0.038
3193	3033	1.515	0.075	1.463	0.166	0.038	0.038
3283	2844	3.031	0.151	2.926	0.332	0.077	0.077
3373	2656	1.515	0.075	1.463	0.166	0.038	0.038
3374	2531	1.515	0.075	1.463	0.166	0.038	0.038
3464	2343	3.031	0.151	2.926	0.332	0.077	0.077
3554	2134	2.020	0.100	1.951	0.222	0.051	0.051
3555	2008	1.010	0.050	0.975	0.111	0.026	0.026
3645	1841	3.031	0.151	2.926	0.332	0.077	0.077
3735	1632	2.020	0.100	1.951	0.222	0.051	0.051
3736	1507	1.010	0.050	0.975	0.111	0.026	0.026
3826	1339	3.031	0.151	2.926	0.332	0.077	0.077
3916	1114	2.424	0.121	2.341	0.266	0.061	0.061
3917	988	0.606	0.030	0.585	0.066	0.015	0.015
4007	838	3.031	0.151	2.926	0.332	0.077	0.077
4097	612	2.424	0.121	2.341	0.266	0.061	0.061
4098	487	0.606	0.030	0.585	0.066	0.015	0.015
4188	336	3.031	0.151	2.926	0.332	0.077	0.077
4278	105	2.546	0.127	2.458	0.279	0.064	0.064
2002 Runways 1L/R Approach Total		**78.960**	**3.930**	**76.234**	**8.654**	**2.000**	**2.000**

Source: CDM 2006.

Table 4-1B
2002 LAS Aircraft Approach Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
6901	6520	0.697	0.035	0.673	0.076	0.018	0.018
6811	6380	5.616	0.279	5.422	0.616	0.142	0.142
6721	6131	5.616	0.279	5.422	0.616	0.142	0.142
6630	5882	5.616	0.279	5.422	0.616	0.142	0.142
6540	5634	5.616	0.279	5.422	0.616	0.142	0.142
6450	5497	0.562	0.028	0.542	0.062	0.014	0.014
6449	5373	5.054	0.251	4.880	0.554	0.128	0.128
6359	5136	5.616	0.279	5.422	0.616	0.142	0.142
6269	4966	2.078	0.103	2.006	0.228	0.053	0.053
6268	4842	3.538	0.176	3.416	0.388	0.089	0.089
6178	4639	5.616	0.279	5.422	0.616	0.142	0.142
6088	4452	2.808	0.140	2.711	0.308	0.071	0.071
6087	4328	2.808	0.140	2.711	0.308	0.071	0.071
5997	4141	5.616	0.279	5.422	0.616	0.142	0.142
5907	3942	3.369	0.168	3.253	0.369	0.085	0.085
5906	3818	2.246	0.112	2.169	0.246	0.057	0.057
5816	3644	5.616	0.279	5.422	0.616	0.142	0.142
5726	3426	4.212	0.209	4.067	0.462	0.107	0.107
5725	3302	1.404	0.070	1.356	0.154	0.036	0.036
5635	3147	5.616	0.279	5.422	0.616	0.142	0.142
5545	2898	5.616	0.279	5.422	0.616	0.142	0.142
5454	2649	5.616	0.279	5.422	0.616	0.142	0.142
5364	2400	5.616	0.279	5.422	0.616	0.142	0.142
5274	2251	1.123	0.056	1.084	0.123	0.028	0.028
5273	2127	4.493	0.223	4.338	0.493	0.114	0.114
5183	1903	5.616	0.279	5.422	0.616	0.142	0.142
5093	1733	2.078	0.103	2.006	0.228	0.053	0.053
5092	1608	3.538	0.176	3.416	0.388	0.089	0.089
5002	1406	5.616	0.279	5.422	0.616	0.142	0.142
4912	1219	2.808	0.140	2.711	0.308	0.071	0.071
4911	1095	2.808	0.140	2.711	0.308	0.071	0.071
4821	908	5.616	0.279	5.422	0.616	0.142	0.142
4731	697	3.931	0.195	3.796	0.431	0.099	0.099
4730	572	1.685	0.084	1.627	0.185	0.043	0.043
4640	411	5.616	0.279	5.422	0.616	0.142	0.142
4550	162	5.616	0.279	5.422	0.616	0.142	0.142
4459	19	0.850	0.042	0.820	0.093	0.021	0.021
2002 Runways 19L/R Approach Total		**147.562**	**7.334**	**142.467**	**16.184**	**3.732**	**3.732**

Source: CDM 2006.

Table 4-1C
2002 LAS Aircraft Approach Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4251	6422	0.362	0.018	0.349	0.040	0.009	0.009
4252	6197	0.362	0.018	0.349	0.040	0.009	0.009
4253	5972	0.362	0.018	0.349	0.040	0.009	0.009
4254	5746	0.362	0.018	0.349	0.040	0.009	0.009
4255	5521	0.362	0.018	0.349	0.040	0.009	0.009
4256	5296	0.362	0.018	0.349	0.040	0.009	0.009
4257	5070	0.362	0.018	0.349	0.040	0.009	0.009
4258	4845	0.362	0.018	0.349	0.040	0.009	0.009
4259	4620	0.362	0.018	0.349	0.040	0.009	0.009
4260	4394	0.362	0.018	0.349	0.040	0.009	0.009
4261	4169	0.362	0.018	0.349	0.040	0.009	0.009
4262	3944	0.362	0.018	0.349	0.040	0.009	0.009
4263	3718	0.362	0.018	0.349	0.040	0.009	0.009
4264	3493	0.362	0.018	0.349	0.040	0.009	0.009
4265	3268	0.362	0.018	0.349	0.040	0.009	0.009
4266	3042	0.362	0.018	0.349	0.040	0.009	0.009
4267	2817	0.362	0.018	0.349	0.040	0.009	0.009
4268	2591	0.362	0.018	0.349	0.040	0.009	0.009
4269	2366	0.362	0.018	0.349	0.040	0.009	0.009
4270	2141	0.362	0.018	0.349	0.040	0.009	0.009
4271	1915	0.362	0.018	0.349	0.040	0.009	0.009
4272	1690	0.362	0.018	0.349	0.040	0.009	0.009
4273	1465	0.362	0.018	0.349	0.040	0.009	0.009
4274	1239	0.362	0.018	0.349	0.040	0.009	0.009
4275	1014	0.362	0.018	0.349	0.040	0.009	0.009
4276	789	0.362	0.018	0.349	0.040	0.009	0.009
4277	563	0.362	0.018	0.349	0.040	0.009	0.009
4278	338	0.362	0.018	0.349	0.040	0.009	0.009
4279	113	0.362	0.018	0.349	0.040	0.009	0.009
2002 Runways 7L/R Approach Total		**10.498**	**0.522**	**10.121**	**1.160**	**0.261**	**0.261**

Source: CDM 2006.

Table 4-1D
2002 LAS Aircraft Approach Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4399	6422	13.873	0.690	13.395	1.521	0.351	0.351
4398	6197	13.873	0.690	13.395	1.521	0.351	0.351
4397	5972	13.873	0.690	13.395	1.521	0.351	0.351
4396	5746	13.873	0.690	13.395	1.521	0.351	0.351
4395	5521	13.873	0.690	13.395	1.521	0.351	0.351
4394	5296	13.873	0.690	13.395	1.521	0.351	0.351
4393	5070	13.873	0.690	13.395	1.521	0.351	0.351
4392	4845	13.873	0.690	13.395	1.521	0.351	0.351
4391	4620	13.873	0.690	13.395	1.521	0.351	0.351
4390	4394	13.873	0.690	13.395	1.521	0.351	0.351
4389	4169	13.873	0.690	13.395	1.521	0.351	0.351
4388	3944	13.873	0.690	13.395	1.521	0.351	0.351
4387	3718	13.873	0.690	13.395	1.521	0.351	0.351
4386	3493	13.873	0.690	13.395	1.521	0.351	0.351
4385	3268	13.873	0.690	13.395	1.521	0.351	0.351
4384	3042	13.873	0.690	13.395	1.521	0.351	0.351
4383	2817	13.873	0.690	13.395	1.521	0.351	0.351
4382	2591	13.873	0.690	13.395	1.521	0.351	0.351
4381	2366	13.873	0.690	13.395	1.521	0.351	0.351
4380	2141	13.873	0.690	13.395	1.521	0.351	0.351
4379	1915	13.873	0.690	13.395	1.521	0.351	0.351
4378	1690	13.873	0.690	13.395	1.521	0.351	0.351
4377	1465	13.873	0.690	13.395	1.521	0.351	0.351
4376	1239	13.873	0.690	13.395	1.521	0.351	0.351
4375	1014	13.873	0.690	13.395	1.521	0.351	0.351
4374	789	13.873	0.690	13.395	1.521	0.351	0.351
4373	563	13.873	0.690	13.395	1.521	0.351	0.351
4372	338	13.873	0.690	13.395	1.521	0.351	0.351
4371	113	13.873	0.690	13.395	1.521	0.351	0.351
2002 Runways 25L/R Approach Total		**402.317**	**20.010**	**388.455**	**44.109**	**10.179**	**10.179**

Source: CDM 2006.

Table 4-2A
2003 LAS Aircraft Approach Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1926	6508	0.855	0.031	0.582	0.066	0.018	0.018
2016	6356	4.004	0.144	2.726	0.308	0.083	0.083
2107	6105	4.004	0.144	2.726	0.308	0.083	0.083
2197	5854	4.004	0.144	2.726	0.308	0.083	0.083
2288	5604	4.004	0.144	2.726	0.308	0.083	0.083
2378	5353	4.004	0.144	2.726	0.308	0.083	0.083
2468	5212	0.500	0.018	0.341	0.039	0.010	0.010
2469	5086	3.503	0.126	2.385	0.270	0.072	0.072
2559	4851	4.004	0.144	2.726	0.308	0.083	0.083
2649	4705	0.667	0.024	0.454	0.051	0.014	0.014
2650	4579	3.336	0.120	2.272	0.257	0.069	0.069
2740	4349	4.004	0.144	2.726	0.308	0.083	0.083
2830	4193	1.001	0.036	0.682	0.077	0.021	0.021
2831	4067	3.003	0.108	2.045	0.231	0.062	0.062
2921	3848	4.004	0.144	2.726	0.308	0.083	0.083
3011	3675	1.501	0.054	1.022	0.116	0.031	0.031
3012	3550	2.502	0.090	1.704	0.193	0.052	0.052
3102	3346	4.004	0.144	2.726	0.308	0.083	0.083
3192	3158	2.002	0.072	1.363	0.154	0.041	0.041
3193	3033	2.002	0.072	1.363	0.154	0.041	0.041
3283	2844	4.004	0.144	2.726	0.308	0.083	0.083
3373	2656	2.002	0.072	1.363	0.154	0.041	0.041
3374	2531	2.002	0.072	1.363	0.154	0.041	0.041
3464	2343	4.004	0.144	2.726	0.308	0.083	0.083
3554	2134	2.669	0.096	1.817	0.205	0.055	0.055
3555	2008	1.335	0.048	0.909	0.103	0.028	0.028
3645	1841	4.004	0.144	2.726	0.308	0.083	0.083
3735	1632	2.669	0.096	1.817	0.205	0.055	0.055
3736	1507	1.335	0.048	0.909	0.103	0.028	0.028
3826	1339	4.004	0.144	2.726	0.308	0.083	0.083
3916	1114	3.203	0.115	2.181	0.246	0.066	0.066
3917	988	0.801	0.029	0.545	0.062	0.017	0.017
4007	838	4.004	0.144	2.726	0.308	0.083	0.083
4097	612	3.203	0.115	2.181	0.246	0.066	0.066
4098	487	0.801	0.029	0.545	0.062	0.017	0.017
4188	336	4.004	0.144	2.726	0.308	0.083	0.083
4278	105	3.363	0.121	2.290	0.259	0.070	0.070
2003 Runways 1L/R Approach Total		**104.315**	**3.752**	**71.023**	**8.027**	**2.160**	**2.160**

Source: CDM 2006.

Table 4-2B
2003 LAS Aircraft Approach Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
6901	6520	0.920	0.033	0.627	0.071	0.019	0.019
6811	6380	7.419	0.266	5.052	0.571	0.153	0.153
6721	6131	7.419	0.266	5.052	0.571	0.153	0.153
6630	5882	7.419	0.266	5.052	0.571	0.153	0.153
6540	5634	7.419	0.266	5.052	0.571	0.153	0.153
6450	5497	0.742	0.027	0.505	0.057	0.015	0.015
6449	5373	6.677	0.240	4.547	0.514	0.138	0.138
6359	5136	7.419	0.266	5.052	0.571	0.153	0.153
6269	4966	2.745	0.099	1.869	0.211	0.057	0.057
6268	4842	4.674	0.168	3.183	0.360	0.097	0.097
6178	4639	7.419	0.266	5.052	0.571	0.153	0.153
6088	4452	3.709	0.133	2.526	0.285	0.077	0.077
6087	4328	3.709	0.133	2.526	0.285	0.077	0.077
5997	4141	7.419	0.266	5.052	0.571	0.153	0.153
5907	3942	4.451	0.160	3.031	0.342	0.092	0.092
5906	3818	2.968	0.107	2.021	0.228	0.061	0.061
5816	3644	7.419	0.266	5.052	0.571	0.153	0.153
5726	3426	5.564	0.200	3.789	0.428	0.115	0.115
5725	3302	1.855	0.067	1.263	0.143	0.038	0.038
5635	3147	7.419	0.266	5.052	0.571	0.153	0.153
5545	2898	7.419	0.266	5.052	0.571	0.153	0.153
5454	2649	7.419	0.266	5.052	0.571	0.153	0.153
5364	2400	7.419	0.266	5.052	0.571	0.153	0.153
5274	2251	1.484	0.053	1.010	0.114	0.031	0.031
5273	2127	5.935	0.213	4.041	0.457	0.123	0.123
5183	1903	7.419	0.266	5.052	0.571	0.153	0.153
5093	1733	2.745	0.099	1.869	0.211	0.057	0.057
5092	1608	4.674	0.168	3.183	0.360	0.097	0.097
5002	1406	7.419	0.266	5.052	0.571	0.153	0.153
4912	1219	3.709	0.133	2.526	0.285	0.077	0.077
4911	1095	3.709	0.133	2.526	0.285	0.077	0.077
4821	908	7.419	0.266	5.052	0.571	0.153	0.153
4731	697	5.193	0.186	3.536	0.400	0.107	0.107
4730	572	2.226	0.080	1.516	0.171	0.046	0.046
4640	411	7.419	0.266	5.052	0.571	0.153	0.153
4550	162	7.419	0.266	5.052	0.571	0.153	0.153
4459	19	1.123	0.040	0.764	0.086	0.023	0.023
2003 Runways 19L/R Approach Total		**194.935**	**6.994**	**132.742**	**15.000**	**4.025**	**4.025**

Source: CDM 2006.

Table 4-2C
2003 LAS Aircraft Approach Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4251	6422	0.478	0.017	0.325	0.037	0.010	0.010
4252	6197	0.478	0.017	0.325	0.037	0.010	0.010
4253	5972	0.478	0.017	0.325	0.037	0.010	0.010
4254	5746	0.478	0.017	0.325	0.037	0.010	0.010
4255	5521	0.478	0.017	0.325	0.037	0.010	0.010
4256	5296	0.478	0.017	0.325	0.037	0.010	0.010
4257	5070	0.478	0.017	0.325	0.037	0.010	0.010
4258	4845	0.478	0.017	0.325	0.037	0.010	0.010
4259	4620	0.478	0.017	0.325	0.037	0.010	0.010
4260	4394	0.478	0.017	0.325	0.037	0.010	0.010
4261	4169	0.478	0.017	0.325	0.037	0.010	0.010
4262	3944	0.478	0.017	0.325	0.037	0.010	0.010
4263	3718	0.478	0.017	0.325	0.037	0.010	0.010
4264	3493	0.478	0.017	0.325	0.037	0.010	0.010
4265	3268	0.478	0.017	0.325	0.037	0.010	0.010
4266	3042	0.478	0.017	0.325	0.037	0.010	0.010
4267	2817	0.478	0.017	0.325	0.037	0.010	0.010
4268	2591	0.478	0.017	0.325	0.037	0.010	0.010
4269	2366	0.478	0.017	0.325	0.037	0.010	0.010
4270	2141	0.478	0.017	0.325	0.037	0.010	0.010
4271	1915	0.478	0.017	0.325	0.037	0.010	0.010
4272	1690	0.478	0.017	0.325	0.037	0.010	0.010
4273	1465	0.478	0.017	0.325	0.037	0.010	0.010
4274	1239	0.478	0.017	0.325	0.037	0.010	0.010
4275	1014	0.478	0.017	0.325	0.037	0.010	0.010
4276	789	0.478	0.017	0.325	0.037	0.010	0.010
4277	563	0.478	0.017	0.325	0.037	0.010	0.010
4278	338	0.478	0.017	0.325	0.037	0.010	0.010
4279	113	0.478	0.017	0.325	0.037	0.010	0.010
2003 Runways 7L/R Approach Total		**13.862**	**0.493**	**9.425**	**1.073**	**0.290**	**0.290**

Source: CDM 2006.

Table 4-2D
2003 LAS Aircraft Approach Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4399	6422	18.328	0.658	12.480	1.410	0.379	0.379
4398	6197	18.328	0.658	12.480	1.410	0.379	0.379
4397	5972	18.328	0.658	12.480	1.410	0.379	0.379
4396	5746	18.328	0.658	12.480	1.410	0.379	0.379
4395	5521	18.328	0.658	12.480	1.410	0.379	0.379
4394	5296	18.328	0.658	12.480	1.410	0.379	0.379
4393	5070	18.328	0.658	12.480	1.410	0.379	0.379
4392	4845	18.328	0.658	12.480	1.410	0.379	0.379
4391	4620	18.328	0.658	12.480	1.410	0.379	0.379
4390	4394	18.328	0.658	12.480	1.410	0.379	0.379
4389	4169	18.328	0.658	12.480	1.410	0.379	0.379
4388	3944	18.328	0.658	12.480	1.410	0.379	0.379
4387	3718	18.328	0.658	12.480	1.410	0.379	0.379
4386	3493	18.328	0.658	12.480	1.410	0.379	0.379
4385	3268	18.328	0.658	12.480	1.410	0.379	0.379
4384	3042	18.328	0.658	12.480	1.410	0.379	0.379
4383	2817	18.328	0.658	12.480	1.410	0.379	0.379
4382	2591	18.328	0.658	12.480	1.410	0.379	0.379
4381	2366	18.328	0.658	12.480	1.410	0.379	0.379
4380	2141	18.328	0.658	12.480	1.410	0.379	0.379
4379	1915	18.328	0.658	12.480	1.410	0.379	0.379
4378	1690	18.328	0.658	12.480	1.410	0.379	0.379
4377	1465	18.328	0.658	12.480	1.410	0.379	0.379
4376	1239	18.328	0.658	12.480	1.410	0.379	0.379
4375	1014	18.328	0.658	12.480	1.410	0.379	0.379
4374	789	18.328	0.658	12.480	1.410	0.379	0.379
4373	563	18.328	0.658	12.480	1.410	0.379	0.379
4372	338	18.328	0.658	12.480	1.410	0.379	0.379
4371	113	18.328	0.658	12.480	1.410	0.379	0.379
2003 Runways 25L/R Approach Total		**531.512**	**19.082**	**361.920**	**40.890**	**10.991**	**10.991**

Source: CDM 2006.

Table 4-3A
2008 LAS Aircraft Approach Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1926	6508	0.774	0.032	0.918	0.101	0.023	0.023
2016	6356	3.624	0.149	4.297	0.473	0.105	0.105
2107	6105	3.624	0.149	4.297	0.473	0.105	0.105
2197	5854	3.624	0.149	4.297	0.473	0.105	0.105
2288	5604	3.624	0.149	4.297	0.473	0.105	0.105
2378	5353	3.624	0.149	4.297	0.473	0.105	0.105
2468	5212	0.453	0.019	0.537	0.059	0.013	0.013
2469	5086	3.171	0.130	3.760	0.414	0.092	0.092
2559	4851	3.624	0.149	4.297	0.473	0.105	0.105
2649	4705	0.604	0.025	0.716	0.079	0.018	0.018
2650	4579	3.020	0.124	3.581	0.394	0.088	0.088
2740	4349	3.624	0.149	4.297	0.473	0.105	0.105
2830	4193	0.906	0.037	1.074	0.118	0.026	0.026
2831	4067	2.718	0.112	3.223	0.355	0.079	0.079
2921	3848	3.624	0.149	4.297	0.473	0.105	0.105
3011	3675	1.359	0.056	1.611	0.177	0.040	0.040
3012	3550	2.265	0.093	2.686	0.296	0.066	0.066
3102	3346	3.624	0.149	4.297	0.473	0.105	0.105
3192	3158	1.812	0.075	2.148	0.236	0.053	0.053
3193	3033	1.812	0.075	2.148	0.236	0.053	0.053
3283	2844	3.624	0.149	4.297	0.473	0.105	0.105
3373	2656	1.812	0.075	2.148	0.236	0.053	0.053
3374	2531	1.812	0.075	2.148	0.236	0.053	0.053
3464	2343	3.624	0.149	4.297	0.473	0.105	0.105
3554	2134	2.416	0.099	2.865	0.315	0.070	0.070
3555	2008	1.208	0.050	1.432	0.158	0.035	0.035
3645	1841	3.624	0.149	4.297	0.473	0.105	0.105
3735	1632	2.416	0.099	2.865	0.315	0.070	0.070
3736	1507	1.208	0.050	1.432	0.158	0.035	0.035
3826	1339	3.624	0.149	4.297	0.473	0.105	0.105
3916	1114	2.899	0.119	3.437	0.378	0.084	0.084
3917	988	0.725	0.030	0.859	0.095	0.021	0.021
4007	838	3.624	0.149	4.297	0.473	0.105	0.105
4097	612	2.899	0.119	3.437	0.378	0.084	0.084
4098	487	0.725	0.030	0.859	0.095	0.021	0.021
4188	336	3.624	0.149	4.297	0.473	0.105	0.105
4278	105	3.045	0.125	3.610	0.397	0.089	0.089
2008 Runways 1L/R Approach Total		**94.419**	**3.884**	**111.949**	**12.321**	**2.741**	**2.741**

Source: CDM 2006.

Table 4-3B
2008 LAS Aircraft Approach Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
6901	6520	0.659	0.027	0.782	0.086	0.019	0.019
6811	6380	5.314	0.219	6.301	0.694	0.155	0.155
6721	6131	5.314	0.219	6.301	0.694	0.155	0.155
6630	5882	5.314	0.219	6.301	0.694	0.155	0.155
6540	5634	5.314	0.219	6.301	0.694	0.155	0.155
6450	5497	0.531	0.022	0.630	0.069	0.015	0.015
6449	5373	4.783	0.197	5.671	0.624	0.139	0.139
6359	5136	5.314	0.219	6.301	0.694	0.155	0.155
6269	4966	1.966	0.081	2.331	0.257	0.057	0.057
6268	4842	3.348	0.138	3.969	0.437	0.097	0.097
6178	4639	5.314	0.219	6.301	0.694	0.155	0.155
6088	4452	2.657	0.109	3.150	0.347	0.077	0.077
6087	4328	2.657	0.109	3.150	0.347	0.077	0.077
5997	4141	5.314	0.219	6.301	0.694	0.155	0.155
5907	3942	3.189	0.131	3.780	0.416	0.093	0.093
5906	3818	2.126	0.087	2.520	0.277	0.062	0.062
5816	3644	5.314	0.219	6.301	0.694	0.155	0.155
5726	3426	3.986	0.164	4.726	0.520	0.116	0.116
5725	3302	1.329	0.055	1.575	0.173	0.039	0.039
5635	3147	5.314	0.219	6.301	0.694	0.155	0.155
5545	2898	5.314	0.219	6.301	0.694	0.155	0.155
5454	2649	5.314	0.219	6.301	0.694	0.155	0.155
5364	2400	5.314	0.219	6.301	0.694	0.155	0.155
5274	2251	1.063	0.044	1.260	0.139	0.031	0.031
5273	2127	4.252	0.175	5.041	0.555	0.124	0.124
5183	1903	5.314	0.219	6.301	0.694	0.155	0.155
5093	1733	1.966	0.081	2.331	0.257	0.057	0.057
5092	1608	3.348	0.138	3.969	0.437	0.097	0.097
5002	1406	5.314	0.219	6.301	0.694	0.155	0.155
4912	1219	2.657	0.109	3.150	0.347	0.077	0.077
4911	1095	2.657	0.109	3.150	0.347	0.077	0.077
4821	908	5.314	0.219	6.301	0.694	0.155	0.155
4731	697	3.720	0.153	4.410	0.486	0.108	0.108
4730	572	1.594	0.066	1.890	0.208	0.046	0.046
4640	411	5.314	0.219	6.301	0.694	0.155	0.155
4550	162	5.314	0.219	6.301	0.694	0.155	0.155
4459	19	0.804	0.033	0.953	0.105	0.023	0.023
2008 Runways 19L/R Approach Total		**139.630**	**5.751**	**165.555**	**18.232**	**4.066**	**4.066**

Source: CDM 2006.

Table 4-3C
2008 LAS Aircraft Approach Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4251	6422	0.424	0.017	0.503	0.055	0.012	0.012
4252	6197	0.424	0.017	0.503	0.055	0.012	0.012
4253	5972	0.424	0.017	0.503	0.055	0.012	0.012
4254	5746	0.424	0.017	0.503	0.055	0.012	0.012
4255	5521	0.424	0.017	0.503	0.055	0.012	0.012
4256	5296	0.424	0.017	0.503	0.055	0.012	0.012
4257	5070	0.424	0.017	0.503	0.055	0.012	0.012
4258	4845	0.424	0.017	0.503	0.055	0.012	0.012
4259	4620	0.424	0.017	0.503	0.055	0.012	0.012
4260	4394	0.424	0.017	0.503	0.055	0.012	0.012
4261	4169	0.424	0.017	0.503	0.055	0.012	0.012
4262	3944	0.424	0.017	0.503	0.055	0.012	0.012
4263	3718	0.424	0.017	0.503	0.055	0.012	0.012
4264	3493	0.424	0.017	0.503	0.055	0.012	0.012
4265	3268	0.424	0.017	0.503	0.055	0.012	0.012
4266	3042	0.424	0.017	0.503	0.055	0.012	0.012
4267	2817	0.424	0.017	0.503	0.055	0.012	0.012
4268	2591	0.424	0.017	0.503	0.055	0.012	0.012
4269	2366	0.424	0.017	0.503	0.055	0.012	0.012
4270	2141	0.424	0.017	0.503	0.055	0.012	0.012
4271	1915	0.424	0.017	0.503	0.055	0.012	0.012
4272	1690	0.424	0.017	0.503	0.055	0.012	0.012
4273	1465	0.424	0.017	0.503	0.055	0.012	0.012
4274	1239	0.424	0.017	0.503	0.055	0.012	0.012
4275	1014	0.424	0.017	0.503	0.055	0.012	0.012
4276	789	0.424	0.017	0.503	0.055	0.012	0.012
4277	563	0.424	0.017	0.503	0.055	0.012	0.012
4278	338	0.424	0.017	0.503	0.055	0.012	0.012
4279	113	0.424	0.017	0.503	0.055	0.012	0.012
2008 Runways 7L/R Approach Total		**12.296**	**0.493**	**14.587**	**1.595**	**0.348**	**0.348**

Source: CDM 2006.

Table 4-3D
2008 LAS Aircraft Approach Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4399	6422	12.717	0.523	15.077	1.660	0.370	0.370
4398	6197	12.717	0.523	15.077	1.660	0.370	0.370
4397	5972	12.717	0.523	15.077	1.660	0.370	0.370
4396	5746	12.717	0.523	15.077	1.660	0.370	0.370
4395	5521	12.717	0.523	15.077	1.660	0.370	0.370
4394	5296	12.717	0.523	15.077	1.660	0.370	0.370
4393	5070	12.717	0.523	15.077	1.660	0.370	0.370
4392	4845	12.717	0.523	15.077	1.660	0.370	0.370
4391	4620	12.717	0.523	15.077	1.660	0.370	0.370
4390	4394	12.717	0.523	15.077	1.660	0.370	0.370
4389	4169	12.717	0.523	15.077	1.660	0.370	0.370
4388	3944	12.717	0.523	15.077	1.660	0.370	0.370
4387	3718	12.717	0.523	15.077	1.660	0.370	0.370
4386	3493	12.717	0.523	15.077	1.660	0.370	0.370
4385	3268	12.717	0.523	15.077	1.660	0.370	0.370
4384	3042	12.717	0.523	15.077	1.660	0.370	0.370
4383	2817	12.717	0.523	15.077	1.660	0.370	0.370
4382	2591	12.717	0.523	15.077	1.660	0.370	0.370
4381	2366	12.717	0.523	15.077	1.660	0.370	0.370
4380	2141	12.717	0.523	15.077	1.660	0.370	0.370
4379	1915	12.717	0.523	15.077	1.660	0.370	0.370
4378	1690	12.717	0.523	15.077	1.660	0.370	0.370
4377	1465	12.717	0.523	15.077	1.660	0.370	0.370
4376	1239	12.717	0.523	15.077	1.660	0.370	0.370
4375	1014	12.717	0.523	15.077	1.660	0.370	0.370
4374	789	12.717	0.523	15.077	1.660	0.370	0.370
4373	563	12.717	0.523	15.077	1.660	0.370	0.370
4372	338	12.717	0.523	15.077	1.660	0.370	0.370
4371	113	12.717	0.523	15.077	1.660	0.370	0.370
2008 Runways 25L/R Approach Total		**368.793**	**15.167**	**437.233**	**48.140**	**10.730**	**10.730**

Source: CDM 2006.

Table 4-4A
2013 LAS Aircraft Approach Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1926	6508	0.803	0.029	1.050	0.113	0.020	0.020
2016	6356	3.762	0.137	4.918	0.531	0.096	0.096
2107	6105	3.762	0.137	4.918	0.531	0.096	0.096
2197	5854	3.762	0.137	4.918	0.531	0.096	0.096
2288	5604	3.762	0.137	4.918	0.531	0.096	0.096
2378	5353	3.762	0.137	4.918	0.531	0.096	0.096
2468	5212	0.470	0.017	0.615	0.066	0.012	0.012
2469	5086	3.292	0.120	4.303	0.464	0.084	0.084
2559	4851	3.762	0.137	4.918	0.531	0.096	0.096
2649	4705	0.627	0.023	0.820	0.088	0.016	0.016
2650	4579	3.135	0.114	4.098	0.442	0.080	0.080
2740	4349	3.762	0.137	4.918	0.531	0.096	0.096
2830	4193	0.941	0.034	1.229	0.133	0.024	0.024
2831	4067	2.822	0.103	3.688	0.398	0.072	0.072
2921	3848	3.762	0.137	4.918	0.531	0.096	0.096
3011	3675	1.411	0.051	1.844	0.199	0.036	0.036
3012	3550	2.351	0.086	3.073	0.332	0.060	0.060
3102	3346	3.762	0.137	4.918	0.531	0.096	0.096
3192	3158	1.881	0.069	2.459	0.265	0.048	0.048
3193	3033	1.881	0.069	2.459	0.265	0.048	0.048
3283	2844	3.762	0.137	4.918	0.531	0.096	0.096
3373	2656	1.881	0.069	2.459	0.265	0.048	0.048
3374	2531	1.881	0.069	2.459	0.265	0.048	0.048
3464	2343	3.762	0.137	4.918	0.531	0.096	0.096
3554	2134	2.508	0.092	3.278	0.354	0.064	0.064
3555	2008	1.254	0.046	1.639	0.177	0.032	0.032
3645	1841	3.762	0.137	4.918	0.531	0.096	0.096
3735	1632	2.508	0.092	3.278	0.354	0.064	0.064
3736	1507	1.254	0.046	1.639	0.177	0.032	0.032
3826	1339	3.762	0.137	4.918	0.531	0.096	0.096
3916	1114	3.010	0.110	3.934	0.425	0.077	0.077
3917	988	0.752	0.027	0.984	0.106	0.019	0.019
4007	838	3.762	0.137	4.918	0.531	0.096	0.096
4097	612	3.010	0.110	3.934	0.425	0.077	0.077
4098	487	0.752	0.027	0.984	0.106	0.019	0.019
4188	336	3.762	0.137	4.918	0.531	0.096	0.096
4278	105	3.160	0.115	4.131	0.446	0.081	0.081
2013 Runways 1L/R Approach Total		**98.014**	**3.573**	**128.127**	**13.830**	**2.501**	**2.501**

Source: CDM 2006.

Table 4-4B
2013 LAS Aircraft Approach Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
6901	6520	0.684	0.025	0.895	0.097	0.017	0.017
6811	6380	5.517	0.201	7.211	0.778	0.141	0.141
6721	6131	5.517	0.201	7.211	0.778	0.141	0.141
6630	5882	5.517	0.201	7.211	0.778	0.141	0.141
6540	5634	5.517	0.201	7.211	0.778	0.141	0.141
6450	5497	0.552	0.020	0.721	0.078	0.014	0.014
6449	5373	4.965	0.181	6.490	0.701	0.126	0.126
6359	5136	5.517	0.201	7.211	0.778	0.141	0.141
6269	4966	2.041	0.074	2.668	0.288	0.052	0.052
6268	4842	3.475	0.127	4.543	0.490	0.089	0.089
6178	4639	5.517	0.201	7.211	0.778	0.141	0.141
6088	4452	2.758	0.101	3.605	0.389	0.070	0.070
6087	4328	2.758	0.101	3.605	0.389	0.070	0.070
5997	4141	5.517	0.201	7.211	0.778	0.141	0.141
5907	3942	3.310	0.121	4.326	0.467	0.084	0.084
5906	3818	2.207	0.081	2.884	0.311	0.056	0.056
5816	3644	5.517	0.201	7.211	0.778	0.141	0.141
5726	3426	4.137	0.151	5.408	0.584	0.105	0.105
5725	3302	1.379	0.050	1.803	0.195	0.035	0.035
5635	3147	5.517	0.201	7.211	0.778	0.141	0.141
5545	2898	5.517	0.201	7.211	0.778	0.141	0.141
5454	2649	5.517	0.201	7.211	0.778	0.141	0.141
5364	2400	5.517	0.201	7.211	0.778	0.141	0.141
5274	2251	1.103	0.040	1.442	0.156	0.028	0.028
5273	2127	4.413	0.161	5.769	0.623	0.112	0.112
5183	1903	5.517	0.201	7.211	0.778	0.141	0.141
5093	1733	2.041	0.074	2.668	0.288	0.052	0.052
5092	1608	3.475	0.127	4.543	0.490	0.089	0.089
5002	1406	5.517	0.201	7.211	0.778	0.141	0.141
4912	1219	2.758	0.101	3.605	0.389	0.070	0.070
4911	1095	2.758	0.101	3.605	0.389	0.070	0.070
4821	908	5.517	0.201	7.211	0.778	0.141	0.141
4731	697	3.862	0.141	5.048	0.545	0.098	0.098
4730	572	1.655	0.060	2.163	0.234	0.042	0.042
4640	411	5.517	0.201	7.211	0.778	0.141	0.141
4550	162	5.517	0.201	7.211	0.778	0.141	0.141
4459	19	0.835	0.030	1.091	0.118	0.021	0.021
2013 Runways 19L/R Approach Total		**144.955**	**5.284**	**189.469**	**20.447**	**3.697**	**3.697**

Source: CDM 2006.

Table 4-4C
2013 LAS Aircraft Approach Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4251	6422	0.440	0.016	0.576	0.062	0.011	0.011
4252	6197	0.440	0.016	0.576	0.062	0.011	0.011
4253	5972	0.440	0.016	0.576	0.062	0.011	0.011
4254	5746	0.440	0.016	0.576	0.062	0.011	0.011
4255	5521	0.440	0.016	0.576	0.062	0.011	0.011
4256	5296	0.440	0.016	0.576	0.062	0.011	0.011
4257	5070	0.440	0.016	0.576	0.062	0.011	0.011
4258	4845	0.440	0.016	0.576	0.062	0.011	0.011
4259	4620	0.440	0.016	0.576	0.062	0.011	0.011
4260	4394	0.440	0.016	0.576	0.062	0.011	0.011
4261	4169	0.440	0.016	0.576	0.062	0.011	0.011
4262	3944	0.440	0.016	0.576	0.062	0.011	0.011
4263	3718	0.440	0.016	0.576	0.062	0.011	0.011
4264	3493	0.440	0.016	0.576	0.062	0.011	0.011
4265	3268	0.440	0.016	0.576	0.062	0.011	0.011
4266	3042	0.440	0.016	0.576	0.062	0.011	0.011
4267	2817	0.440	0.016	0.576	0.062	0.011	0.011
4268	2591	0.440	0.016	0.576	0.062	0.011	0.011
4269	2366	0.440	0.016	0.576	0.062	0.011	0.011
4270	2141	0.440	0.016	0.576	0.062	0.011	0.011
4271	1915	0.440	0.016	0.576	0.062	0.011	0.011
4272	1690	0.440	0.016	0.576	0.062	0.011	0.011
4273	1465	0.440	0.016	0.576	0.062	0.011	0.011
4274	1239	0.440	0.016	0.576	0.062	0.011	0.011
4275	1014	0.440	0.016	0.576	0.062	0.011	0.011
4276	789	0.440	0.016	0.576	0.062	0.011	0.011
4277	563	0.440	0.016	0.576	0.062	0.011	0.011
4278	338	0.440	0.016	0.576	0.062	0.011	0.011
4279	113	0.440	0.016	0.576	0.062	0.011	0.011
2013 Runways 7L/R Approach Total		**12.760**	**0.464**	**16.704**	**1.798**	**0.319**	**0.319**

Source: CDM 2006.

Table 4-4D
2013 LAS Aircraft Approach Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4399	6422	13.200	0.482	17.254	1.862	0.336	0.336
4398	6197	13.200	0.482	17.254	1.862	0.336	0.336
4397	5972	13.200	0.482	17.254	1.862	0.336	0.336
4396	5746	13.200	0.482	17.254	1.862	0.336	0.336
4395	5521	13.200	0.482	17.254	1.862	0.336	0.336
4394	5296	13.200	0.482	17.254	1.862	0.336	0.336
4393	5070	13.200	0.482	17.254	1.862	0.336	0.336
4392	4845	13.200	0.482	17.254	1.862	0.336	0.336
4391	4620	13.200	0.482	17.254	1.862	0.336	0.336
4390	4394	13.200	0.482	17.254	1.862	0.336	0.336
4389	4169	13.200	0.482	17.254	1.862	0.336	0.336
4388	3944	13.200	0.482	17.254	1.862	0.336	0.336
4387	3718	13.200	0.482	17.254	1.862	0.336	0.336
4386	3493	13.200	0.482	17.254	1.862	0.336	0.336
4385	3268	13.200	0.482	17.254	1.862	0.336	0.336
4384	3042	13.200	0.482	17.254	1.862	0.336	0.336
4383	2817	13.200	0.482	17.254	1.862	0.336	0.336
4382	2591	13.200	0.482	17.254	1.862	0.336	0.336
4381	2366	13.200	0.482	17.254	1.862	0.336	0.336
4380	2141	13.200	0.482	17.254	1.862	0.336	0.336
4379	1915	13.200	0.482	17.254	1.862	0.336	0.336
4378	1690	13.200	0.482	17.254	1.862	0.336	0.336
4377	1465	13.200	0.482	17.254	1.862	0.336	0.336
4376	1239	13.200	0.482	17.254	1.862	0.336	0.336
4375	1014	13.200	0.482	17.254	1.862	0.336	0.336
4374	789	13.200	0.482	17.254	1.862	0.336	0.336
4373	563	13.200	0.482	17.254	1.862	0.336	0.336
4372	338	13.200	0.482	17.254	1.862	0.336	0.336
4371	113	13.200	0.482	17.254	1.862	0.336	0.336
2013 Runways 25L/R Approach Total		**382.800**	**13.978**	**500.366**	**53.998**	**9.744**	**9.744**

Source: CDM 2006.

Table 4-5A
2018 LAS Aircraft Approach Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1926	6508	0.961	0.035	1.362	0.145	0.025	0.025
2016	6356	4.499	0.163	6.380	0.680	0.118	0.118
2107	6105	4.499	0.163	6.380	0.680	0.118	0.118
2197	5854	4.499	0.163	6.380	0.680	0.118	0.118
2288	5604	4.499	0.163	6.380	0.680	0.118	0.118
2378	5353	4.499	0.163	6.380	0.680	0.118	0.118
2468	5212	0.562	0.020	0.798	0.085	0.015	0.015
2469	5086	3.937	0.142	5.583	0.595	0.104	0.104
2559	4851	4.499	0.163	6.380	0.680	0.118	0.118
2649	4705	0.750	0.027	1.063	0.113	0.020	0.020
2650	4579	3.749	0.135	5.317	0.566	0.099	0.099
2740	4349	4.499	0.163	6.380	0.680	0.118	0.118
2830	4193	1.125	0.041	1.595	0.170	0.030	0.030
2831	4067	3.374	0.122	4.785	0.510	0.089	0.089
2921	3848	4.499	0.163	6.380	0.680	0.118	0.118
3011	3675	1.687	0.061	2.393	0.255	0.044	0.044
3012	3550	2.812	0.102	3.988	0.425	0.074	0.074
3102	3346	4.499	0.163	6.380	0.680	0.118	0.118
3192	3158	2.249	0.081	3.190	0.340	0.059	0.059
3193	3033	2.249	0.081	3.190	0.340	0.059	0.059
3283	2844	4.499	0.163	6.380	0.680	0.118	0.118
3373	2656	2.249	0.081	3.190	0.340	0.059	0.059
3374	2531	2.249	0.081	3.190	0.340	0.059	0.059
3464	2343	4.499	0.163	6.380	0.680	0.118	0.118
3554	2134	2.999	0.108	4.254	0.453	0.079	0.079
3555	2008	1.500	0.054	2.127	0.227	0.039	0.039
3645	1841	4.499	0.163	6.380	0.680	0.118	0.118
3735	1632	2.999	0.108	4.254	0.453	0.079	0.079
3736	1507	1.500	0.054	2.127	0.227	0.039	0.039
3826	1339	4.499	0.163	6.380	0.680	0.118	0.118
3916	1114	3.599	0.130	5.104	0.544	0.095	0.095
3917	988	0.900	0.033	1.276	0.136	0.024	0.024
4007	838	4.499	0.163	6.380	0.680	0.118	0.118
4097	612	3.599	0.130	5.104	0.544	0.095	0.095
4098	487	0.900	0.033	1.276	0.136	0.024	0.024
4188	336	4.499	0.163	6.380	0.680	0.118	0.118
4278	105	3.779	0.137	5.360	0.571	0.100	0.100
2018 Runways 1L/R Approach Total		**117.213**	**4.241**	**166.226**	**17.715**	**3.080**	**3.080**

Source: CDM 2006.

Table 4-5B
2018 LAS Aircraft Approach Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
6901	6520	0.703	0.025	0.997	0.106	0.019	0.019
6811	6380	5.667	0.205	8.037	0.856	0.149	0.149
6721	6131	5.667	0.205	8.037	0.856	0.149	0.149
6630	5882	5.667	0.205	8.037	0.856	0.149	0.149
6540	5634	5.667	0.205	8.037	0.856	0.149	0.149
6450	5497	0.567	0.020	0.804	0.086	0.015	0.015
6449	5373	5.101	0.184	7.234	0.771	0.134	0.134
6359	5136	5.667	0.205	8.037	0.856	0.149	0.149
6269	4966	2.097	0.076	2.974	0.317	0.055	0.055
6268	4842	3.570	0.129	5.064	0.539	0.094	0.094
6178	4639	5.667	0.205	8.037	0.856	0.149	0.149
6088	4452	2.834	0.102	4.019	0.428	0.075	0.075
6087	4328	2.834	0.102	4.019	0.428	0.075	0.075
5997	4141	5.667	0.205	8.037	0.856	0.149	0.149
5907	3942	3.400	0.123	4.822	0.514	0.090	0.090
5906	3818	2.267	0.082	3.215	0.342	0.060	0.060
5816	3644	5.667	0.205	8.037	0.856	0.149	0.149
5726	3426	4.250	0.154	6.028	0.642	0.112	0.112
5725	3302	1.417	0.051	2.009	0.214	0.037	0.037
5635	3147	5.667	0.205	8.037	0.856	0.149	0.149
5545	2898	5.667	0.205	8.037	0.856	0.149	0.149
5454	2649	5.667	0.205	8.037	0.856	0.149	0.149
5364	2400	5.667	0.205	8.037	0.856	0.149	0.149
5274	2251	1.133	0.041	1.607	0.171	0.030	0.030
5273	2127	4.534	0.164	6.430	0.685	0.119	0.119
5183	1903	5.667	0.205	8.037	0.856	0.149	0.149
5093	1733	2.097	0.076	2.974	0.317	0.055	0.055
5092	1608	3.570	0.129	5.064	0.539	0.094	0.094
5002	1406	5.667	0.205	8.037	0.856	0.149	0.149
4912	1219	2.834	0.102	4.019	0.428	0.075	0.075
4911	1095	2.834	0.102	4.019	0.428	0.075	0.075
4821	908	5.667	0.205	8.037	0.856	0.149	0.149
4731	697	3.967	0.143	5.626	0.599	0.104	0.104
4730	572	1.700	0.061	2.411	0.257	0.045	0.045
4640	411	5.667	0.205	8.037	0.856	0.149	0.149
4550	162	5.667	0.205	8.037	0.856	0.149	0.149
4459	19	0.858	0.031	1.216	0.130	0.023	0.023
2018 Runways 19L/R Approach Total		**148.906**	**5.382**	**211.180**	**22.493**	**3.919**	**3.919**

Source: CDM 2006.

Table 4-5C
2018 LAS Aircraft Approach Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4251	6422	0.518	0.019	0.735	0.078	0.014	0.014
4252	6197	0.518	0.019	0.735	0.078	0.014	0.014
4253	5972	0.518	0.019	0.735	0.078	0.014	0.014
4254	5746	0.518	0.019	0.735	0.078	0.014	0.014
4255	5521	0.518	0.019	0.735	0.078	0.014	0.014
4256	5296	0.518	0.019	0.735	0.078	0.014	0.014
4257	5070	0.518	0.019	0.735	0.078	0.014	0.014
4258	4845	0.518	0.019	0.735	0.078	0.014	0.014
4259	4620	0.518	0.019	0.735	0.078	0.014	0.014
4260	4394	0.518	0.019	0.735	0.078	0.014	0.014
4261	4169	0.518	0.019	0.735	0.078	0.014	0.014
4262	3944	0.518	0.019	0.735	0.078	0.014	0.014
4263	3718	0.518	0.019	0.735	0.078	0.014	0.014
4264	3493	0.518	0.019	0.735	0.078	0.014	0.014
4265	3268	0.518	0.019	0.735	0.078	0.014	0.014
4266	3042	0.518	0.019	0.735	0.078	0.014	0.014
4267	2817	0.518	0.019	0.735	0.078	0.014	0.014
4268	2591	0.518	0.019	0.735	0.078	0.014	0.014
4269	2366	0.518	0.019	0.735	0.078	0.014	0.014
4270	2141	0.518	0.019	0.735	0.078	0.014	0.014
4271	1915	0.518	0.019	0.735	0.078	0.014	0.014
4272	1690	0.518	0.019	0.735	0.078	0.014	0.014
4273	1465	0.518	0.019	0.735	0.078	0.014	0.014
4274	1239	0.518	0.019	0.735	0.078	0.014	0.014
4275	1014	0.518	0.019	0.735	0.078	0.014	0.014
4276	789	0.518	0.019	0.735	0.078	0.014	0.014
4277	563	0.518	0.019	0.735	0.078	0.014	0.014
4278	338	0.518	0.019	0.735	0.078	0.014	0.014
4279	113	0.518	0.019	0.735	0.078	0.014	0.014
2018 Runways 7L/R Approach Total		**15.022**	**0.551**	**21.315**	**2.262**	**0.406**	**0.406**

Source: CDM 2006.

Table 4-5D
2018 LAS Aircraft Approach Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4399	6422	12.936	0.467	18.345	1.954	0.341	0.341
4398	6197	12.936	0.467	18.345	1.954	0.341	0.341
4397	5972	12.936	0.467	18.345	1.954	0.341	0.341
4396	5746	12.936	0.467	18.345	1.954	0.341	0.341
4395	5521	12.936	0.467	18.345	1.954	0.341	0.341
4394	5296	12.936	0.467	18.345	1.954	0.341	0.341
4393	5070	12.936	0.467	18.345	1.954	0.341	0.341
4392	4845	12.936	0.467	18.345	1.954	0.341	0.341
4391	4620	12.936	0.467	18.345	1.954	0.341	0.341
4390	4394	12.936	0.467	18.345	1.954	0.341	0.341
4389	4169	12.936	0.467	18.345	1.954	0.341	0.341
4388	3944	12.936	0.467	18.345	1.954	0.341	0.341
4387	3718	12.936	0.467	18.345	1.954	0.341	0.341
4386	3493	12.936	0.467	18.345	1.954	0.341	0.341
4385	3268	12.936	0.467	18.345	1.954	0.341	0.341
4384	3042	12.936	0.467	18.345	1.954	0.341	0.341
4383	2817	12.936	0.467	18.345	1.954	0.341	0.341
4382	2591	12.936	0.467	18.345	1.954	0.341	0.341
4381	2366	12.936	0.467	18.345	1.954	0.341	0.341
4380	2141	12.936	0.467	18.345	1.954	0.341	0.341
4379	1915	12.936	0.467	18.345	1.954	0.341	0.341
4378	1690	12.936	0.467	18.345	1.954	0.341	0.341
4377	1465	12.936	0.467	18.345	1.954	0.341	0.341
4376	1239	12.936	0.467	18.345	1.954	0.341	0.341
4375	1014	12.936	0.467	18.345	1.954	0.341	0.341
4374	789	12.936	0.467	18.345	1.954	0.341	0.341
4373	563	12.936	0.467	18.345	1.954	0.341	0.341
4372	338	12.936	0.467	18.345	1.954	0.341	0.341
4371	113	12.936	0.467	18.345	1.954	0.341	0.341
2018 Runways 25L/R Approach Total		**375.144**	**13.543**	**532.005**	**56.666**	**9.889**	**9.889**

Source: CDM 2006.

Table 4-6A
2002 LAS Aircraft Climbout Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4459	1042	0.934	0.022	2.424	0.119	0.029	0.029
4550	1361	6.171	0.144	16.022	0.789	0.189	0.189
4640	1916	6.171	0.144	16.022	0.789	0.189	0.189
4730	2276	1.851	0.043	4.807	0.237	0.057	0.057
4731	2554	4.320	0.101	11.216	0.552	0.132	0.132
4821	3025	6.171	0.144	16.022	0.789	0.189	0.189
4911	3441	3.086	0.072	8.011	0.394	0.094	0.094
4912	3718	3.086	0.072	8.011	0.394	0.094	0.094
5002	4134	6.171	0.144	16.022	0.789	0.189	0.189
5092	4586	3.888	0.091	10.094	0.497	0.119	0.119
5093	4863	2.283	0.053	5.928	0.292	0.070	0.070
5183	5243	6.171	0.144	16.022	0.789	0.189	0.189
5273	5742	4.937	0.115	12.818	0.631	0.151	0.151
5274	6020	1.234	0.029	3.204	0.158	0.038	0.038
5364	6305	5.119	0.119	13.291	0.654	0.156	0.156
2002 Runways 1L/R Climbout Total		**61.593**	**1.437**	**159.914**	**7.873**	**1.885**	**1.885**

Source: CDM 2006.

Table 4-6B
2002 LAS Aircraft Climbout Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4278	1209	11.381	0.265	29.549	1.455	0.348	0.348
4188	1697	15.240	0.355	39.568	1.948	0.466	0.466
4098	2033	3.048	0.071	7.914	0.390	0.093	0.093
4097	2313	12.192	0.284	31.655	1.558	0.373	0.373
4007	2816	15.240	0.355	39.568	1.948	0.466	0.466
3917	3151	3.048	0.071	7.914	0.390	0.093	0.093
3916	3431	12.192	0.284	31.655	1.558	0.373	0.373
3826	3934	15.240	0.355	39.568	1.948	0.466	0.466
3736	4307	5.080	0.118	13.189	0.649	0.155	0.155
3735	4587	10.160	0.237	26.379	1.299	0.310	0.310
3645	5053	15.240	0.355	39.568	1.948	0.466	0.466
3555	5426	5.080	0.118	13.189	0.649	0.155	0.155
3554	5706	10.160	0.237	26.379	1.299	0.310	0.310
3464	6172	15.240	0.355	39.568	1.948	0.466	0.466
3374	6493	2.283	0.053	5.926	0.292	0.070	0.070
2002 Runways 19L/R Climbout Total		**150.824**	**3.513**	**391.589**	**19.279**	**4.610**	**4.610**

Source: CDM 2006.

Table 4-6C
2002 LAS Aircraft Climbout Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4372	1252	3.442	0.080	8.936	0.440	0.105	0.105
4373	1755	3.442	0.080	8.936	0.440	0.105	0.105
4374	2258	3.442	0.080	8.936	0.440	0.105	0.105
4375	2761	3.442	0.080	8.936	0.440	0.105	0.105
4376	3264	3.442	0.080	8.936	0.440	0.105	0.105
4377	3768	3.442	0.080	8.936	0.440	0.105	0.105
4378	4271	3.442	0.080	8.936	0.440	0.105	0.105
4379	4774	3.442	0.080	8.936	0.440	0.105	0.105
4380	5277	3.442	0.080	8.936	0.440	0.105	0.105
4381	5780	3.442	0.080	8.936	0.440	0.105	0.105
4382	6283	3.442	0.080	8.936	0.440	0.105	0.105
2002 Runways 7L/R Climbout Total		**37.862**	**0.880**	**98.296**	**4.840**	**1.155**	**1.155**

Source: CDM 2006.

Table 4-6D
2002 LAS Aircraft Climbout Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4279	1126	11.974	0.279	31.088	1.530	0.366	0.366
4278	1629	23.947	0.558	62.177	3.061	0.732	0.732
4277	2132	23.947	0.558	62.177	3.061	0.732	0.732
4276	2635	23.947	0.558	62.177	3.061	0.732	0.732
4275	3139	23.947	0.558	62.177	3.061	0.732	0.732
4274	3642	23.947	0.558	62.177	3.061	0.732	0.732
4273	4145	23.947	0.558	62.177	3.061	0.732	0.732
4272	4648	23.947	0.558	62.177	3.061	0.732	0.732
4271	5151	23.947	0.558	62.177	3.061	0.732	0.732
4270	5654	23.947	0.558	62.177	3.061	0.732	0.732
4269	6158	23.947	0.558	62.177	3.061	0.732	0.732
4268	6409	11.974	0.279	31.088	1.530	0.366	0.366
2002 Runways 25L/R Climbout Total		**263.418**	**6.138**	**683.946**	**33.670**	**8.052**	**8.052**

Source: CDM 2006.

Table 4-7A
2003 LAS Aircraft Climbout Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4459	1042	1.331	0.023	2.039	0.100	0.030	0.030
4550	1361	8.799	0.150	13.474	0.661	0.197	0.197
4640	1916	8.799	0.150	13.474	0.661	0.197	0.197
4730	2276	2.640	0.045	4.042	0.198	0.059	0.059
4731	2554	6.159	0.105	9.432	0.463	0.138	0.138
4821	3025	8.799	0.150	13.474	0.661	0.197	0.197
4911	3441	4.399	0.075	6.737	0.330	0.098	0.098
4912	3718	4.399	0.075	6.737	0.330	0.098	0.098
5002	4134	8.799	0.150	13.474	0.661	0.197	0.197
5092	4586	5.543	0.095	8.488	0.416	0.124	0.124
5093	4863	3.256	0.056	4.985	0.245	0.073	0.073
5183	5243	8.799	0.150	13.474	0.661	0.197	0.197
5273	5742	7.039	0.120	10.779	0.529	0.157	0.157
5274	6020	1.760	0.030	2.695	0.132	0.039	0.039
5364	6305	7.299	0.125	11.177	0.548	0.163	0.163
2003 Runways 1L/R Climbout Total		**87.820**	**1.499**	**134.481**	**6.596**	**1.964**	**1.964**

Source: CDM 2006.

Table 4-7B
2003 LAS Aircraft Climbout Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4278	1209	16.227	0.277	24.848	1.219	0.363	0.363
4188	1697	21.729	0.371	33.274	1.632	0.486	0.486
4098	2033	4.346	0.074	6.655	0.326	0.097	0.097
4097	2313	17.383	0.297	26.619	1.306	0.389	0.389
4007	2816	21.729	0.371	33.274	1.632	0.486	0.486
3917	3151	4.346	0.074	6.655	0.326	0.097	0.097
3916	3431	17.383	0.297	26.619	1.306	0.389	0.389
3826	3934	21.729	0.371	33.274	1.632	0.486	0.486
3736	4307	7.243	0.124	11.091	0.544	0.162	0.162
3735	4587	14.486	0.247	22.183	1.088	0.324	0.324
3645	5053	21.729	0.371	33.274	1.632	0.486	0.486
3555	5426	7.243	0.124	11.091	0.544	0.162	0.162
3554	5706	14.486	0.247	22.183	1.088	0.324	0.324
3464	6172	21.729	0.371	33.274	1.632	0.486	0.486
3374	6493	3.255	0.056	4.984	0.244	0.073	0.073
2003 Runways 19L/R Climbout Total		**215.043**	**3.672**	**329.298**	**16.151**	**4.810**	**4.810**

Source: CDM 2006.

Table 4-7C
2003 LAS Aircraft Climbout Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4372	1252	4.907	0.084	7.515	0.369	0.110	0.110
4373	1755	4.907	0.084	7.515	0.369	0.110	0.110
4374	2258	4.907	0.084	7.515	0.369	0.110	0.110
4375	2761	4.907	0.084	7.515	0.369	0.110	0.110
4376	3264	4.907	0.084	7.515	0.369	0.110	0.110
4377	3768	4.907	0.084	7.515	0.369	0.110	0.110
4378	4271	4.907	0.084	7.515	0.369	0.110	0.110
4379	4774	4.907	0.084	7.515	0.369	0.110	0.110
4380	5277	4.907	0.084	7.515	0.369	0.110	0.110
4381	5780	4.907	0.084	7.515	0.369	0.110	0.110
4382	6283	4.907	0.084	7.515	0.369	0.110	0.110
2003 Runways 7L/R Climbout Total		**53.977**	**0.924**	**82.665**	**4.059**	**1.210**	**1.210**

Source: CDM 2006.

Table 4-7D
2003 LAS Aircraft Climbout Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4279	1126	17.072	0.292	26.143	1.282	0.382	0.382
4278	1629	34.145	0.583	52.286	2.565	0.763	0.763
4277	2132	34.145	0.583	52.286	2.565	0.763	0.763
4276	2635	34.145	0.583	52.286	2.565	0.763	0.763
4275	3139	34.145	0.583	52.286	2.565	0.763	0.763
4274	3642	34.145	0.583	52.286	2.565	0.763	0.763
4273	4145	34.145	0.583	52.286	2.565	0.763	0.763
4272	4648	34.145	0.583	52.286	2.565	0.763	0.763
4271	5151	34.145	0.583	52.286	2.565	0.763	0.763
4270	5654	34.145	0.583	52.286	2.565	0.763	0.763
4269	6158	34.145	0.583	52.286	2.565	0.763	0.763
4268	6409	17.072	0.292	26.143	1.282	0.382	0.382
2003 Runways 25L/R Climbout Total		**375.594**	**6.414**	**575.146**	**28.214**	**8.394**	**8.394**

Source: CDM 2006.

Table 4-8A
2008 LAS Aircraft Climbout Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4459	1042	1.035	0.023	3.293	0.158	0.038	0.038
4550	1361	6.838	0.154	21.762	1.044	0.250	0.250
4640	1916	6.838	0.154	21.762	1.044	0.250	0.250
4730	2276	2.051	0.046	6.529	0.313	0.075	0.075
4731	2554	4.787	0.108	15.234	0.731	0.175	0.175
4821	3025	6.838	0.154	21.762	1.044	0.250	0.250
4911	3441	3.419	0.077	10.881	0.522	0.125	0.125
4912	3718	3.419	0.077	10.881	0.522	0.125	0.125
5002	4134	6.838	0.154	21.762	1.044	0.250	0.250
5092	4586	4.308	0.097	13.710	0.658	0.157	0.157
5093	4863	2.530	0.057	8.052	0.386	0.092	0.092
5183	5243	6.838	0.154	21.762	1.044	0.250	0.250
5273	5742	5.471	0.123	17.410	0.835	0.200	0.200
5274	6020	1.368	0.031	4.352	0.209	0.050	0.050
5364	6305	5.672	0.127	18.052	0.866	0.207	0.207
2008 Runways 1L/R Climbout Total		**68.250**	**1.536**	**217.204**	**10.420**	**2.494**	**2.494**

Source: CDM 2006.

Table 4-8B
2008 LAS Aircraft Climbout Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4278	1209	8.798	0.198	27.999	1.344	0.321	0.321
4188	1697	11.781	0.265	37.492	1.799	0.430	0.430
4098	2033	2.356	0.053	7.498	0.360	0.086	0.086
4097	2313	9.425	0.212	29.994	1.439	0.344	0.344
4007	2816	11.781	0.265	37.492	1.799	0.430	0.430
3917	3151	2.356	0.053	7.498	0.360	0.086	0.086
3916	3431	9.425	0.212	29.994	1.439	0.344	0.344
3826	3934	11.781	0.265	37.492	1.799	0.430	0.430
3736	4307	3.927	0.088	12.497	0.600	0.143	0.143
3735	4587	7.854	0.176	24.995	1.199	0.287	0.287
3645	5053	11.781	0.265	37.492	1.799	0.430	0.430
3555	5426	3.927	0.088	12.497	0.600	0.143	0.143
3554	5706	7.854	0.176	24.995	1.199	0.287	0.287
3464	6172	11.781	0.265	37.492	1.799	0.430	0.430
3374	6493	1.765	0.040	5.615	0.269	0.064	0.064
2008 Runways 19L/R Climbout Total		**116.592**	**2.621**	**371.042**	**17.804**	**4.255**	**4.255**

Source: CDM 2006.

Table 4-8C
2002 LAS Aircraft Climbout Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4372	1252	6.822	0.153	21.711	1.042	0.249	0.249
4373	1755	6.822	0.153	21.711	1.042	0.249	0.249
4374	2258	6.822	0.153	21.711	1.042	0.249	0.249
4375	2761	6.822	0.153	21.711	1.042	0.249	0.249
4376	3264	6.822	0.153	21.711	1.042	0.249	0.249
4377	3768	6.822	0.153	21.711	1.042	0.249	0.249
4378	4271	6.822	0.153	21.711	1.042	0.249	0.249
4379	4774	6.822	0.153	21.711	1.042	0.249	0.249
4380	5277	6.822	0.153	21.711	1.042	0.249	0.249
4381	5780	6.822	0.153	21.711	1.042	0.249	0.249
4382	6283	6.822	0.153	21.711	1.042	0.249	0.249
2008 Runways 7L/R Climbout Total		**75.042**	**1.683**	**238.821**	**11.462**	**2.739**	**2.739**

Source: CDM 2006.

Table 4-8D
2008 LAS Aircraft Climbout Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4279	1126	8.665	0.195	27.574	1.323	0.316	0.316
4278	1629	17.329	0.389	55.149	2.646	0.633	0.633
4277	2132	17.329	0.389	55.149	2.646	0.633	0.633
4276	2635	17.329	0.389	55.149	2.646	0.633	0.633
4275	3139	17.329	0.389	55.149	2.646	0.633	0.633
4274	3642	17.329	0.389	55.149	2.646	0.633	0.633
4273	4145	17.329	0.389	55.149	2.646	0.633	0.633
4272	4648	17.329	0.389	55.149	2.646	0.633	0.633
4271	5151	17.329	0.389	55.149	2.646	0.633	0.633
4270	5654	17.329	0.389	55.149	2.646	0.633	0.633
4269	6158	17.329	0.389	55.149	2.646	0.633	0.633
4268	6409	8.665	0.195	27.574	1.323	0.316	0.316
2008 Runways 25L/R Climbout Total		**190.620**	**4.280**	**606.638**	**29.106**	**6.962**	**6.962**

Source: CDM 2006.

Table 4-9A
2013 LAS Aircraft Climbout Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4459	1042	1.074	0.023	3.786	0.178	0.034	0.034
4550	1361	7.095	0.155	25.020	1.176	0.223	0.223
4640	1916	7.095	0.155	25.020	1.176	0.223	0.223
4730	2276	2.129	0.046	7.506	0.353	0.067	0.067
4731	2554	4.967	0.108	17.514	0.823	0.156	0.156
4821	3025	7.095	0.155	25.020	1.176	0.223	0.223
4911	3441	3.548	0.077	12.510	0.588	0.112	0.112
4912	3718	3.548	0.077	12.510	0.588	0.112	0.112
5002	4134	7.095	0.155	25.020	1.176	0.223	0.223
5092	4586	4.470	0.097	15.763	0.741	0.141	0.141
5093	4863	2.625	0.057	9.257	0.435	0.083	0.083
5183	5243	7.095	0.155	25.020	1.176	0.223	0.223
5273	5742	5.676	0.124	20.016	0.941	0.178	0.178
5274	6020	1.419	0.031	5.004	0.235	0.045	0.045
5364	6305	5.886	0.128	20.755	0.976	0.185	0.185
2013 Runways 1L/R Climbout Total		**70.817**	**1.543**	**249.721**	**11.738**	**2.228**	**2.228**

Source: CDM 2006.

Table 4-9B
2013 LAS Aircraft Climbout Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4278	1209	9.129	0.199	32.189	1.513	0.287	0.287
4188	1697	12.224	0.266	43.104	2.026	0.384	0.384
4098	2033	2.445	0.053	8.621	0.405	0.077	0.077
4097	2313	9.779	0.213	34.483	1.621	0.307	0.307
4007	2816	12.224	0.266	43.104	2.026	0.384	0.384
3917	3151	2.445	0.053	8.621	0.405	0.077	0.077
3916	3431	9.779	0.213	34.483	1.621	0.307	0.307
3826	3934	12.224	0.266	43.104	2.026	0.384	0.384
3736	4307	4.075	0.089	14.368	0.675	0.128	0.128
3735	4587	8.149	0.178	28.736	1.351	0.256	0.256
3645	5053	12.224	0.266	43.104	2.026	0.384	0.384
3555	5426	4.075	0.089	14.368	0.675	0.128	0.128
3554	5706	8.149	0.178	28.736	1.351	0.256	0.256
3464	6172	12.224	0.266	43.104	2.026	0.384	0.384
3374	6493	1.831	0.040	6.456	0.304	0.058	0.058
2013 Runways 19L/R Climbout Total		**120.976**	**2.635**	**426.581**	**20.051**	**3.801**	**3.801**

Source: CDM 2006.

Table 4-9C
2013 LAS Aircraft Climbout Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4372	1252	7.079	0.154	24.961	1.173	0.223	0.223
4373	1755	7.079	0.154	24.961	1.173	0.223	0.223
4374	2258	7.079	0.154	24.961	1.173	0.223	0.223
4375	2761	7.079	0.154	24.961	1.173	0.223	0.223
4376	3264	7.079	0.154	24.961	1.173	0.223	0.223
4377	3768	7.079	0.154	24.961	1.173	0.223	0.223
4378	4271	7.079	0.154	24.961	1.173	0.223	0.223
4379	4774	7.079	0.154	24.961	1.173	0.223	0.223
4380	5277	7.079	0.154	24.961	1.173	0.223	0.223
4381	5780	7.079	0.154	24.961	1.173	0.223	0.223
4382	6283	7.079	0.154	24.961	1.173	0.223	0.223
2013 Runways 7L/R Climbout Total		**77.869**	**1.694**	**274.571**	**12.903**	**2.453**	**2.453**

Source: CDM 2006.

Table 4-9D
2013 LAS Aircraft Climbout Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4279	1126	8.990	0.196	31.702	1.490	0.283	0.283
4278	1629	17.981	0.392	63.404	2.981	0.565	0.565
4277	2132	17.981	0.392	63.404	2.981	0.565	0.565
4276	2635	17.981	0.392	63.404	2.981	0.565	0.565
4275	3139	17.981	0.392	63.404	2.981	0.565	0.565
4274	3642	17.981	0.392	63.404	2.981	0.565	0.565
4273	4145	17.981	0.392	63.404	2.981	0.565	0.565
4272	4648	17.981	0.392	63.404	2.981	0.565	0.565
4271	5151	17.981	0.392	63.404	2.981	0.565	0.565
4270	5654	17.981	0.392	63.404	2.981	0.565	0.565
4269	6158	17.981	0.392	63.404	2.981	0.565	0.565
4268	6409	8.990	0.196	31.702	1.490	0.283	0.283
2013 Runways 25L/R Climbout Total		**197.790**	**4.312**	**697.444**	**32.790**	**6.216**	**6.216**

Source: CDM 2006.

Table 4-10A
2018 LAS Aircraft Climbout Emissions for Runways 1L and 1R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4459	1042	1.236	0.028	4.907	0.228	0.041	0.041
4550	1361	8.170	0.185	32.428	1.506	0.274	0.274
4640	1916	8.170	0.185	32.428	1.506	0.274	0.274
4730	2276	2.451	0.056	9.728	0.452	0.082	0.082
4731	2554	5.719	0.130	22.699	1.054	0.192	0.192
4821	3025	8.170	0.185	32.428	1.506	0.274	0.274
4911	3441	4.085	0.093	16.214	0.753	0.137	0.137
4912	3718	4.085	0.093	16.214	0.753	0.137	0.137
5002	4134	8.170	0.185	32.428	1.506	0.274	0.274
5092	4586	5.147	0.117	20.430	0.949	0.172	0.172
5093	4863	3.023	0.069	11.998	0.557	0.101	0.101
5183	5243	8.170	0.185	32.428	1.506	0.274	0.274
5273	5742	6.536	0.148	25.942	1.205	0.219	0.219
5274	6020	1.634	0.037	6.486	0.301	0.055	0.055
5364	6305	6.777	0.154	26.899	1.249	0.227	0.227
2018 Runways 1L/R Climbout Total		**81.543**	**1.850**	**323.657**	**15.031**	**2.733**	**2.733**

Source: CDM 2006.

Table 4-10B
2018 LAS Aircraft Climbout Emissions for Runways 19L and 19R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4278	1209	8.197	0.186	32.536	1.511	0.275	0.275
4188	1697	10.977	0.249	43.568	2.023	0.368	0.368
4098	2033	2.195	0.050	8.714	0.405	0.074	0.074
4097	2313	8.782	0.199	34.854	1.618	0.294	0.294
4007	2816	10.977	0.249	43.568	2.023	0.368	0.368
3917	3151	2.195	0.050	8.714	0.405	0.074	0.074
3916	3431	8.782	0.199	34.854	1.618	0.294	0.294
3826	3934	10.977	0.249	43.568	2.023	0.368	0.368
3736	4307	3.659	0.083	14.523	0.674	0.123	0.123
3735	4587	7.318	0.166	29.045	1.349	0.245	0.245
3645	5053	10.977	0.249	43.568	2.023	0.368	0.368
3555	5426	3.659	0.083	14.523	0.674	0.123	0.123
3554	5706	7.318	0.166	29.045	1.349	0.245	0.245
3464	6172	10.977	0.249	43.568	2.023	0.368	0.368
3374	6493	1.644	0.037	6.525	0.303	0.055	0.055
2018 Runways 19L/R Climbout Total		**108.634**	**2.464**	**431.173**	**20.021**	**3.642**	**3.642**

Source: CDM 2006.

Table 4-10C
2018 LAS Aircraft Climbout Emissions for Runways 7L and 7R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4372	1252	9.438	0.214	37.462	1.739	0.316	0.316
4373	1755	9.438	0.214	37.462	1.739	0.316	0.316
4374	2258	9.438	0.214	37.462	1.739	0.316	0.316
4375	2761	9.438	0.214	37.462	1.739	0.316	0.316
4376	3264	9.438	0.214	37.462	1.739	0.316	0.316
4377	3768	9.438	0.214	37.462	1.739	0.316	0.316
4378	4271	9.438	0.214	37.462	1.739	0.316	0.316
4379	4774	9.438	0.214	37.462	1.739	0.316	0.316
4380	5277	9.438	0.214	37.462	1.739	0.316	0.316
4381	5780	9.438	0.214	37.462	1.739	0.316	0.316
4382	6283	9.438	0.214	37.462	1.739	0.316	0.316
2018 Runways 7L/R Climbout Total		**103.818**	**2.354**	**412.082**	**19.129**	**3.476**	**3.476**

Source: CDM 2006.

Table 4-10D
2018 LAS Aircraft Climbout Emissions for Runways 25L and 25R

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4279	1126	7.865	0.178	31.218	1.450	0.263	0.263
4278	1629	15.731	0.357	62.436	2.899	0.527	0.527
4277	2132	15.731	0.357	62.436	2.899	0.527	0.527
4276	2635	15.731	0.357	62.436	2.899	0.527	0.527
4275	3139	15.731	0.357	62.436	2.899	0.527	0.527
4274	3642	15.731	0.357	62.436	2.899	0.527	0.527
4273	4145	15.731	0.357	62.436	2.899	0.527	0.527
4272	4648	15.731	0.357	62.436	2.899	0.527	0.527
4271	5151	15.731	0.357	62.436	2.899	0.527	0.527
4270	5654	15.731	0.357	62.436	2.899	0.527	0.527
4269	6158	15.731	0.357	62.436	2.899	0.527	0.527
4268	6409	7.865	0.178	31.218	1.450	0.263	0.263
2018 Runways 25L/R Climbout Total		**173.040**	**3.926**	**686.796**	**31.890**	**5.796**	**5.796**

Source: CDM 2006.

Table 4-11A
2018 IVP Aircraft Approach Emissions for South Flow

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
4453	7741	8.431	0.363	21.770	2.276	0.226	0.226
4362	7492	7.181	0.309	18.542	1.939	0.192	0.192
4272	7264	7.181	0.309	18.542	1.939	0.192	0.192
4182	7035	7.181	0.309	18.542	1.939	0.192	0.192
4092	6806	7.181	0.309	18.542	1.939	0.192	0.192
4002	6578	7.181	0.309	18.542	1.939	0.192	0.192
3912	6360	6.463	0.278	16.688	1.745	0.173	0.173
3911	6246	0.718	0.031	1.854	0.194	0.019	0.019
3821	6120	7.181	0.309	18.542	1.939	0.192	0.192
3731	5892	7.181	0.309	18.542	1.939	0.192	0.192
3641	5663	7.181	0.309	18.542	1.939	0.192	0.192
3551	5434	7.181	0.309	18.542	1.939	0.192	0.192
3461	5206	7.181	0.309	18.542	1.939	0.192	0.192
3371	5000	5.745	0.247	14.834	1.551	0.154	0.154
3370	4886	1.436	0.062	3.708	0.388	0.038	0.038
3280	4748	7.181	0.309	18.542	1.939	0.192	0.192
3190	4520	7.181	0.309	18.542	1.939	0.192	0.192
3100	4291	7.181	0.309	18.542	1.939	0.192	0.192
3010	4062	7.181	0.309	18.542	1.939	0.192	0.192
2920	3834	7.181	0.309	18.542	1.939	0.192	0.192
2830	3637	5.170	0.222	13.350	1.396	0.138	0.138
2829	3523	2.011	0.087	5.192	0.543	0.054	0.054
2739	3376	7.181	0.309	18.542	1.939	0.192	0.192
2649	3148	7.181	0.309	18.542	1.939	0.192	0.192
2559	2919	7.181	0.309	18.542	1.939	0.192	0.192
2469	2691	7.181	0.309	18.542	1.939	0.192	0.192
2379	2462	7.181	0.309	18.542	1.939	0.192	0.192
2289	2279	4.309	0.185	11.125	1.163	0.115	0.115
2288	2165	2.872	0.124	7.417	0.775	0.077	0.077
2198	2005	7.181	0.309	18.542	1.939	0.192	0.192
2108	1776	7.181	0.309	18.542	1.939	0.192	0.192
2018	1547	7.181	0.309	18.542	1.939	0.192	0.192
1928	1319	7.181	0.309	18.542	1.939	0.192	0.192
1838	1090	7.181	0.309	18.542	1.939	0.192	0.192
1748	930	2.872	0.124	7.417	0.775	0.077	0.077
1747	816	4.309	0.185	11.125	1.163	0.115	0.115
1657	633	7.181	0.309	18.542	1.939	0.192	0.192
1567	404	7.181	0.309	18.542	1.939	0.192	0.192
1477	175	7.181	0.309	18.542	1.939	0.192	0.192
1387	31	1.917	0.082	4.949	0.517	0.051	0.051
2018 South Flow Approach Total		**247.321**	**10.642**	**638.605**	**66.778**	**6.613**	**6.613**

Source: CDM 2006.

Table 4-11B
2018 IVP Aircraft Approach Emissions for North Flow

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
35	2902	1.534	0.066	3.960	0.414	0.041	0.041
125	2673	1.534	0.066	3.960	0.414	0.041	0.041
215	2444	1.534	0.066	3.960	0.414	0.041	0.041
305	2216	1.534	0.066	3.960	0.414	0.041	0.041
395	1987	1.534	0.066	3.960	0.414	0.041	0.041
485	1758	1.534	0.066	3.960	0.414	0.041	0.041
575	1553	1.227	0.053	3.168	0.331	0.033	0.033
576	1438	0.307	0.013	0.792	0.083	0.008	0.008
666	1301	1.534	0.066	3.960	0.414	0.041	0.041
756	1072	1.534	0.066	3.960	0.414	0.041	0.041
846	844	1.534	0.066	3.960	0.414	0.041	0.041
936	615	1.534	0.066	3.960	0.414	0.041	0.041
1026	386	1.534	0.066	3.960	0.414	0.041	0.041
1116	158	1.534	0.066	3.960	0.414	0.041	0.041
1206	22	0.291	0.013	0.752	0.079	0.008	0.008
South of fine grid*		32.596	1.402	84.164	8.799	0.872	0.872
2018 North Flow Approach Total		**52.829**	**2.273**	**136.396**	**14.260**	**1.413**	**1.413**

Source: CDM 2006.
*These emissions occur south of the fine 1.3 km x 1.3 km grid system that covers most of Clark County, and occur between 3,000 ft and 7,875 ft above ground level.

Table 4-12A
2018 IVP Aircraft Climbout Emissions for South Flow

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1206	1048	1.218	0.097	22.608	0.968	0.116	0.116
1116	1352	6.418	0.509	119.104	5.101	0.612	0.612
1026	1862	6.418	0.509	119.104	5.101	0.612	0.612
936	2371	6.418	0.509	119.104	5.101	0.612	0.612
846	2881	6.418	0.509	119.104	5.101	0.612	0.612
756	3391	6.418	0.509	119.104	5.101	0.612	0.612
666	3901	6.418	0.509	119.104	5.101	0.612	0.612
576	4207	1.284	0.102	23.821	1.020	0.122	0.122
575	4462	5.135	0.407	95.283	4.081	0.489	0.489
485	4921	6.418	0.509	119.104	5.101	0.612	0.612
395	5430	6.418	0.509	119.104	5.101	0.612	0.612
305	5940	6.418	0.509	119.104	5.101	0.612	0.612
215	6450	6.418	0.509	119.104	5.101	0.612	0.612
125	6960	6.418	0.509	119.104	5.101	0.612	0.612
35	7470	8.311	0.659	154.230	6.606	0.792	0.792
2018 South Flow Climbout Total		**86.546**	**6.864**	**1,606.086**	**68.786**	**8.251**	**8.251**

Source: CDM 2006.

Table 4-12B
2018 IVP Aircraft Climbout Emissions for North Flow

CMAQ Grid Cell No.	Ht AGL (feet)	CO (tpy)	VOC (tpy)	NOx (tpy)	SO2 (tpy)	PM10 (tpy)	PM25 (tpy)
1387	1068	0.366	0.029	6.790	0.291	0.035	0.035
1477	1391	1.371	0.109	25.440	1.090	0.131	0.131
1567	1901	1.371	0.109	25.440	1.090	0.131	0.131
1657	2411	1.371	0.109	25.440	1.090	0.131	0.131
1747	2819	0.823	0.065	15.264	0.654	0.078	0.078
1748	3073	0.548	0.043	10.176	0.436	0.052	0.052
1838	3430	1.371	0.109	25.440	1.090	0.131	0.131
1928	3940	1.371	0.109	25.440	1.090	0.131	0.131
2018	4450	1.371	0.109	25.440	1.090	0.131	0.131
2108	4960	1.371	0.109	25.440	1.090	0.131	0.131
2198	5470	1.371	0.109	25.440	1.090	0.131	0.131
2288	5827	0.548	0.043	10.176	0.436	0.052	0.052
2289	6081	0.823	0.065	15.264	0.654	0.078	0.078
2379	6489	1.371	0.109	25.440	1.090	0.131	0.131
2469	6999	1.371	0.109	25.440	1.090	0.131	0.131
2559	7509	1.371	0.109	25.440	1.090	0.131	0.131
2649	7819	0.299	0.024	5.541	0.237	0.028	0.028
2018 South Flow Climbout Total		**18.488**	**1.468**	**343.051**	**14.698**	**1.764**	**1.764**

Source: CDM 2006.

Section 5
References

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Ricondo 2006e. Personal communication: J. Bergener (Ricondo) to C. van Hueven (Kaplan Kirsch & Rockwell), re: "IVP Air Traffic Flows vs. LAS Air Traffic Flows," August 11, 2006.

Ricondo 2006f. Personal communication: A. Jones (Ricondo) to J. Pehrson (CDM), re: "Emissions info for McCarran and IVP - Grid cell numbers," August 31, 2006.

Attachment 1

Data Excerpted from EDMS DEPARTRS.DBF File

Excerpts from EDMS file DEPARTRS.DBF

INM_NAME	STAGE	WEIGHT_LBS	NUM_POINTS	HORIZ_FT_1	HORIZ_FT_2	HORIZ_FT_3	HORIZ_FT_4	HORIZ_FT_5	VERT_FT_1	VERT_FT_2	VERT_FT_3	VERT_FT_4	VERT_FT_5	FT/S_1	FT/S_2	FT/S_3	FT/S_4	FT/S_5	TIME_1000	TIME_3000
717200	1	121000	3	0.00	5544.70	11783.80	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	275.9569	280.0077	0.0000	0.0000	62.9160	119.1689
737300	1	119000	3	0.00	5505.50	10946.90	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	277.8135	282.0331	0.0000	0.0000	59.3989	112.1620
757PW	1	222000	3	0.00	5123.00	10385.40	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	274.6067	278.6574	0.0000	0.0000	56.6751	123.4487
767300	1	367700	3	0.00	5456.70	11180.40	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	291.9911	296.3795	0.0000	0.0000	57.1266	127.8877
777200	1	535000	5	0.00	6330.20	6557.90	6651.00	13071.90	0.00	0.00	35.00	46.00	1000.00	0.0000	276.4633	276.6320	276.9696	280.8516	70.2399	157.0570
A320	1	162000	3	0.00	5131.50	10867.20	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	270.8935	274.9442	0.0000	0.0000	59.2189	119.8682
A32123	1	196200	3	0.00	6090.90	11980.70	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	292.3287	296.7170	0.0000	0.0000	61.9556	126.0517
C130	1	155000	3	0.00	6731.80	16794.50	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	242.2007	245.7451	0.0000	0.0000	97.0369	216.6623
CNA172	1	2450	4	0.00	1000.00	2890.50	11294.00	0.00	0.00	0.00	151.00	1000.00	0.00	0.0000	92.8295	126.9233	128.4423	0.0000	104.9558	301.7585
CNA441	1	9850	5	0.00	2082.10	3022.00	5195.20	9197.55	0.00	0.00	103.30	313.90	1000.00	0.0000	185.6591	202.8748	237.3061	239.7634	54.2406	102.8840
COMSEP	1	2440	4	0.00	699.40	1861.30	11081.20	0.00	0.00	0.00	69.70	1000.00	0.00	0.0000	99.5808	126.7545	128.4423	0.0000	96.9565	291.2244
DC910	1	85000	3	0.00	3133.40	8113.20	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	234.7744	238.3188	0.0000	0.0000	48.1652	103.8836
DHC8	1	31000	3	0.00	1794.40	6346.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.0000	168.4434	170.8064	0.0000	0.0000	48.7790	113.8621
LEAR25	1	15000	4	0.00	3688.70	5676.60	9531.71	0.00	0.00	0.00	214.30	1000.00	0.00	0.0000	263.2984	289.4594	292.8631	0.0000	48.7661	85.5580

717-200							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
5,544.70	-	275.96	40.19	5,544.70	6.87	-	-
11,783.80	1,000.00	280.01	62.92	11,863.43	0.18	43.99	3.87
27,407.56	3,000.00	280.01	119.17	27,614.68	-	35.55	(0.30)
65,490.46	7,875.00	280.01	256.29	66,008.34	-	35.55	-
737-300							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
5,505.50	-	277.81	39.63	5,505.50	7.01	-	-
10,946.90	1,000.00	282.03	59.40	11,038.03	0.21	50.60	5.12
25,692.83	3,000.00	282.03	112.16	25,918.97	-	37.91	(0.48)
61,636.03	7,875.00	282.03	240.77	62,191.26	-	37.91	-
757-200							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
5,123.00	-	274.61	37.31	5,123.00	7.36	-	-
10,385.40	1,000.00	278.66	56.68	10,479.57	0.21	51.64	5.33
28,884.56	3,000.00	278.66	123.45	29,086.53	-	29.95	(0.65)
73,976.26	7,875.00	278.66	286.21	74,440.99	-	29.95	-
767-300							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
5,456.70	-	291.99	37.38	5,456.70	7.81	-	-
11,180.40	1,000.00	296.38	57.13	11,267.10	0.22	50.63	5.13
32,056.96	3,000.00	296.38	127.89	32,239.24	-	28.26	(0.63)
82,943.56	7,875.00	296.38	300.37	83,358.83	-	28.26	-
777-200							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
6,330.20	-	276.46	45.79	6,330.20	6.04	-	-
6,557.90	35.00	276.63	46.63	6,560.57	0.20	42.01	100.87
6,651.00	46.00	276.97	46.97	6,654.32	1.00	32.48	(56.31)
13,071.90	1,000.00	280.85	70.24	13,145.71	0.17	40.99	0.73
37,372.46	3,000.00	280.85	157.06	37,528.43	-	23.04	(0.41)
96,605.07	7,875.00	280.85	368.67	96,961.31	-	23.04	-
A320							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
5,131.50	-	270.89	37.89	5,131.50	7.15	-	-
10,867.20	1,000.00	274.94	59.22	10,953.72	0.19	46.88	4.39
27,422.00	3,000.00	274.94	119.87	27,628.89	-	32.98	(0.46)
67,774.33	7,875.00	274.94	267.70	68,274.63	-	32.98	-
A321							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
6,090.90	-	292.33	41.67	6,090.90	7.02	-	-
11,980.70	1,000.00	296.72	61.96	12,064.99	0.22	49.30	4.86
30,893.65	3,000.00	296.72	126.05	31,083.39	-	31.20	(0.56)
76,993.96	7,875.00	296.72	282.29	77,440.75	-	31.20	-

Black values taken from DEPARTRS.DBF;
Red values calculated by CDM.

Departure Flight Profiles for IVP/LAS Aircraft

C-130							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
6,731.80	-	242.20	55.59	6,731.80	4.36	-	-
16,794.50	1,000.00	245.75	97.04	16,844.07	0.09	24.13	1.16
46,123.74	3,000.00	245.75	216.66	46,241.42	-	16.72	(0.12)
117,613.78	7,875.00	245.75	508.25	117,897.48	-	16.72	-

Cessna 150							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
1,000.00	-	92.83	21.54	1,000.00	4.31	-	-
2,890.50	151.00	126.92	38.81	2,896.52	1.98	8.75	1.01
11,294.00	1,000.00	128.44	104.96	11,342.80	0.02	12.83	0.12
36,492.55	3,000.00	128.44	301.76	36,620.59	-	10.16	(0.03)
97,914.00	7,875.00	128.44	781.47	98,235.21	-	10.16	-

Cessna 441							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
2,082.10	-	185.66	22.43	2,082.10	8.28	-	-
3,022.00	103.30	202.87	27.30	3,027.66	3.54	21.22	8.72
5,195.20	313.90	237.31	37.22	5,211.04	3.47	21.23	0.00
9,197.55	1,000.00	239.76	54.24	9,271.77	0.14	40.30	2.24
20,687.69	3,000.00	239.76	102.88	20,934.68	-	41.12	0.03
48,694.92	7,875.00	239.76	221.45	49,363.01	-	41.12	-

Commanche							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
699.40	-	99.58	14.05	699.40	7.09	-	-
1,861.30	69.70	126.75	24.33	1,863.39	2.64	6.78	1.32
11,081.20	1,000.00	128.44	96.96	11,130.10	0.02	12.81	0.17
35,953.13	3,000.00	128.44	291.22	36,082.32	-	10.30	(0.03)
96,578.47	7,875.00	128.44	764.75	96,903.35	-	10.30	-

DC9-20							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
3,133.40	-	234.77	26.69	3,133.40	8.80	-	-
8,113.20	1,000.00	238.32	48.17	8,212.61	0.17	46.57	4.34
21,240.46	3,000.00	238.32	103.88	21,491.36	-	35.89	(0.38)
53,238.16	7,875.00	238.32	239.70	53,858.29	-	35.89	-

Dash 8							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
1,794.40	-	168.44	21.31	1,794.40	7.91	-	-
6,346.00	1,000.00	170.81	48.78	6,454.56	0.09	36.40	2.65
17,281.22	3,000.00	170.81	113.86	17,571.17	-	30.73	(0.17)
43,935.82	7,875.00	170.81	272.50	44,667.90	-	30.73	-

Lear 24D							
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)	Climb (ft/s)	CAccel (ft/s^2)
-	-	-	-	-	na	-	-
3,688.70	-	263.30	28.02	3,688.70	9.40	-	-
5,676.60	214.30	289.46	35.25	5,688.12	3.62	29.62	8.19
9,531.71	1,000.00	292.86	48.77	9,622.48	0.25	58.15	4.22
20,119.46	3,000.00	292.86	85.56	20,397.47	-	54.36	(0.21)
45,927.09	7,875.00	292.86	175.24	46,661.51	-	54.36	-

Black values taken from DEPARTRS.DBF;
Red values calculated by CDM.

Composite (Operations-Weighted) Departure Profile

IVP-2018				AIR_NAME		ANNUAL_OPS	
Ops Weighted Climbout				B717-200		37240	
Horiz (ft)	Vert (ft)			B737-300		37240	
-	0			B757-200		27084	
5,500.00	0			B767-300		5642	
11,092.97	1000			B777-200		5642	
19,566.29	2000			A320		27084	
44,986.23	5000			A321		27084	
57,992.77	6535			C-130 HERCULES		632	
69,347.01	7875			Cessna 150		1812	
26,727.23	3000			Cessna 441 Conquest2		3581	
56538	6341			Comanche		2642	
				DC9-20		4350	
				Dash 8-300		2700	
				Learjet 24D		1332	
Horizontal distance referenced to beginning of takeoff roll (0,0).							
Vertical distance is elevation above ground level.							

Attachment 2

Data Excerpted from EDMS ARRIVALS.DBF File

INM_NAME	STAGE	WEIGHT_LBS	NUM_POINTS	HORIZ_FT_1	HORIZ_FT_2	HORIZ_FT_3	HORIZ_FT_4	HORIZ_FT_5	HORIZ_FT_6	HORIZ_FT_7	HORIZ_FT_8	HORIZ_FT_9	VERT_FT_1	VERT_FT_2	VERT_FT_3	VERT_FT_4
717200	1	99000	4	-19081.10	0.00	318.60	3186.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
737300	1	102600	4	-19081.10	0.00	316.80	3168.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
757300	1	201600	8	-18054.53	-13722.00	-9245.00	-4784.00	-954.00	0.00	312.60	3126.00	0.00	1000.00	760.00	511.00	263.00
767300	1	288000	4	-19081.10	0.00	328.50	3285.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
777200	1	368700	5	-17890.00	-890.00	0.00	445.00	4450.00	0.00	0.00	0.00	0.00	1000.00	50.00	0.00	0.00
A320	1	128000	5	-19080.70	-954.10	0.00	293.00	2930.00	0.00	0.00	0.00	0.00	1000.00	50.00	0.00	0.00
A32123	1	149800	6	-19081.00	-9025.00	-954.00	0.00	504.00	5037.00	0.00	0.00	0.00	1000.00	473.00	50.00	0.00
C130	1	121500	4	-19081.10	0.00	341.10	3411.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
CNA172	1	2450	6	-19081.10	-11448.70	-9540.60	0.00	30.00	560.00	0.00	0.00	0.00	1000.00	600.00	500.00	0.00
CNA441	1	8424	4	-19081.10	0.00	79.10	791.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
COMSEP	1	2160	4	-19081.10	0.00	46.80	468.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
DC910	1	73500	4	-19081.10	0.00	357.30	3573.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
DHC8	1	30500	4	-19081.10	0.00	174.60	1746.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00
LEAR25	1	12200	4	-19081.10	0.00	140.40	1404.00	0.00	0.00	0.00	0.00	0.00	1000.00	0.00	0.00	0.00

INM_NAME	STAGE	WEIGHT_LBS	NUM_POINTS	VERT_FT_5	VERT_FT_6	VERT_FT_7	VERT_FT_8	VERT_FT_9	FT/S_1	FT/S_2	FT/S_3	FT/S_4	FT/S_5	FT/S_6	FT/S_7	FT/S_8	FT/S_9	TIME_1000	TIME_3000
717200	1	99000	4	0.00	0.00	0.00	0.00	0.00	239.8378	221.1031	219.4153	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	105.5882	236.3874
737300	1	102600	4	0.00	0.00	0.00	0.00	0.00	238.1500	234.6056	222.6221	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	103.0877	244.7664
757300	1	201600	8	50.00	0.00	0.00	0.00	0.00	238.9634	238.1500	237.3061	236.4622	235.7870	234.0992	222.2846	50.6343	0.0000	98.2103	251.5933
767300	1	288000	4	0.00	0.00	0.00	0.00	0.00	234.7744	231.3988	219.5841	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	105.3142	251.8540
777200	1	368700	5	0.00	0.00	0.00	0.00	0.00	212.6641	209.2884	207.6006	195.7860	50.6343	0.0000	0.0000	0.0000	0.0000	119.6917	337.4802
A320	1	128000	5	0.00	0.00	0.00	0.00	0.00	218.5714	215.5333	213.8455	202.0309	50.6343	0.0000	0.0000	0.0000	0.0000	110.3599	261.6059
A32123	1	149800	6	0.00	0.00	0.00	0.00	0.00	228.6983	226.8417	225.4914	223.8036	211.9889	50.6343	0.0000	0.0000	0.0000	121.0319	260.1534
C130	1	121500	4	0.00	0.00	0.00	0.00	0.00	232.5802	229.2046	217.5587	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	107.1743	251.9756
CNA172	1	2450	6	0.00	0.00	0.00	0.00	0.00	137.0502	136.2063	118.9906	109.7076	104.6442	16.8781	0.0000	0.0000	0.0000	163.4647	438.2411
CNA441	1	8424	4	0.00	0.00	0.00	0.00	0.00	160.8483	158.4854	150.3839	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	127.2649	334.1902
COMSEP	1	2160	4	0.00	0.00	0.00	0.00	0.00	100.7623	99.2432	94.1798	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	197.3686	549.1566
DC910	1	73500	4	0.00	0.00	0.00	0.00	0.00	222.9597	219.7529	208.4445	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	112.8121	267.0136
DHC8	1	30500	4	0.00	0.00	0.00	0.00	0.00	152.4092	150.2151	142.4512	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	143.7472	364.0361
LEAR25	1	12200	4	0.00	0.00	0.00	0.00	0.00	242.7071	238.9939	226.8417	50.6343	0.0000	0.0000	0.0000	0.0000	0.0000	89.0432	231.7851

Arrival Flight Profiles for IVP/LAS Aircraft

717-200					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,263.66)	7,875.00	344.49	506.78	153,655.88	-
(57,243.30)	3,000.00	344.49	236.39	60,507.86	0.80
(19,081.10)	1,000.00	239.84	105.59	22,293.29	0.23
-	-	221.10	22.68	3,186.00	1.17
318.60	-	219.42	21.24	2,867.40	7.95
3,186.00	-	50.63	-	-	-
737-300					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,263.66)	7,875.00	301.30	553.92	153,637.88	-
(57,243.30)	3,000.00	301.30	244.77	60,489.86	0.45
(19,081.10)	1,000.00	238.15	103.09	22,275.29	0.04
-	-	234.61	22.25	3,168.00	8.65
316.80	-	222.62	20.87	2,851.20	8.24
3,168.00	-	50.63	-	-	-
757-200					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(142,163.46)	7,875.00	293.40	552.00	145,507.41	-
(54,158.95)	3,000.00	293.40	251.59	57,367.98	0.35
(18,054.53)	1,000.00	238.96	98.21	21,208.21	0.04
(13,722.00)	760.00	238.15	37.72	16,869.03	0.04
(9,245.00)	511.00	237.31	18.86	12,385.12	0.04
(4,784.00)	263.00	236.46	-	7,917.23	0.04
(954.00)	50.00	235.79		4,081.31	0.42
-	-	234.10		3,126.00	8.62
312.60	-	222.28	20.62	2,813.40	8.33
3,126.00	-	50.63	-	-	-
767-300					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,263.66)	7,875.00	286.78	576.66	153,754.88	-
(57,243.30)	3,000.00	286.78	251.85	60,606.86	0.35
(19,081.10)	1,000.00	234.77	105.31	22,392.29	0.04
-	-	231.40	23.34	3,285.00	8.11
328.50	-	219.58	21.88	2,956.50	7.72
3,285.00	-	50.63	-	-	-
777-200					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(140,916.32)	7,875.00	289.96	638.81	145,586.19	-
(53,679.47)	3,000.00	289.96	337.48	58,213.24	0.35
(17,890.00)	1,000.00	212.66	119.69	22,367.93	0.04
(890.00)	50.00	209.29	38.99	5,341.40	0.39
-	-	207.60	34.71	4,450.00	5.35
445.00	-	195.79	32.51	4,005.00	4.47
4,450.00	-	50.63	-	-	-

Black values taken from ARRIVLAS.DBF;
Red values calculated by CDM.

A320					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,260.04)	7,875.00	286.75	586.44	153,396.26	-
(57,241.96)	3,000.00	286.75	261.61	60,250.52	0.45
(19,080.70)	1,000.00	218.57	110.36	22,036.89	0.04
(954.10)	50.00	215.53	26.73	3,885.41	0.38
-	-	213.85	22.28	2,930.00	8.38
293.00	-	202.03	20.87	2,637.00	7.25
2,930.00	-	50.63	-	-	-
A321					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,266.96)	7,875.00	320.69	550.63	155,510.17	-
(57,244.19)	3,000.00	320.69	260.15	62,359.74	0.66
(19,081.00)	1,000.00	228.70	121.03	24,144.19	0.04
(9,025.00)	473.00	226.84	76.82	14,074.39	0.04
(954.00)	50.00	225.49	41.09	5,992.31	0.40
-	-	223.80	36.83	5,037.00	5.11
504.00	-	211.99	34.52	4,533.00	4.67
5,037.00	-	50.63	-	-	-
C-130					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,263.66)	7,875.00	295.24	567.47	153,880.88	-
(57,243.30)	3,000.00	295.24	251.98	60,732.86	0.43
(19,081.10)	1,000.00	232.58	107.17	22,518.29	0.04
-	-	229.20	24.42	3,411.00	7.63
341.10	-	217.56	22.89	3,069.90	7.29
3,411.00	-	50.63	-	-	-
Cessna 150					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,262.98)	7,875.00	141.10	1,098.40	151,029.19	-
(57,243.10)	3,000.00	141.10	438.24	57,881.66	0.01
(19,081.10)	1,000.00	137.05	163.46	19,667.29	0.02
(11,448.70)	600.00	136.21	107.53	12,024.41	1.15
(9,540.60)	500.00	118.99	92.55	10,113.69	0.11
-	-	109.71	9.00	560.00	18.09
30.00	-	104.64	8.72	530.00	10.06
560.00	-	16.88	-	-	-
Cessna 441					
Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
(150,263.66)	7,875.00	208.51	780.93	151,260.88	-
(57,243.30)	3,000.00	208.51	334.19	58,112.86	0.23
(19,081.10)	1,000.00	160.85	127.26	19,898.29	0.02
-	-	158.49	7.60	791.00	15.82
79.10	-	150.38	7.08	711.90	14.08
791.00	-	50.63	-	-	-

Black values taken from ARRIVLAS.DBF;
Red values calculated by CDM.

		Commanche					
		Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
		(150,263.66)	7,875.00	116.50	1,348.73	150,937.88	-
		(57,243.30)	3,000.00	116.50	549.16	57,789.86	0.04
		(19,081.10)	1,000.00	100.76	197.37	19,575.29	0.01
		-	-	99.24	6.30	468.00	10.46
		46.80	-	94.18	5.82	421.20	7.49
		468.00	-	50.63	-	-	-
		DC9-20					
		Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
		(150,263.66)	7,875.00	272.68	608.61	154,042.88	-
		(57,243.30)	3,000.00	272.68	267.01	60,894.86	0.32
		(19,081.10)	1,000.00	222.96	112.81	22,680.29	0.04
		-	-	219.75	26.49	3,573.00	6.78
		357.30	-	208.44	24.82	3,215.70	6.36
		3,573.00	-	50.63	-	-	-
		Dash 8					
		Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
		(150,263.66)	7,875.00	194.54	842.85	152,215.88	-
		(57,243.30)	3,000.00	194.54	364.04	59,067.86	0.19
		(19,081.10)	1,000.00	152.41	143.75	20,853.29	0.02
		-	-	150.22	17.47	1,746.00	6.51
		174.60	-	142.45	16.28	1,571.40	5.64
		1,746.00	-	50.63	-	-	-
		Lear 24D			89.0432	231.7851	
		Horiz (ft)	Vert (ft)	Speed (ft/s)	time (s)	Distance (ft)	Accel (ft/s^2)
		(150,263.66)	7,875.00	292.73	549.99	151,873.88	-
		(57,243.30)	3,000.00	292.73	231.79	58,725.86	0.35
		(19,081.10)	1,000.00	242.71	89.04	20,511.29	0.05
		-	-	238.99	9.71	1,404.00	20.16
		140.40	-	226.84	9.11	1,263.60	19.35
		1,404.00	-	50.63	-	-	-

Black values taken from ARRIVLAS.DBF;
Red values calculated by CDM.

Composite (Operations-Weighted) Arrival Profile

IVP 2018			AIR_NAME		ANNUAL_OPS	
Operations Weighted Arrival Profile			B757-200		27084	
Horiz (ft)	Vert (ft)		B767-300		5642	
(148,785.69)	7875		A320		27084	
(132,253.95)	7000		DC9-20		4350	
(113,360.53)	6000		C-130 HERCULES		632	
(94,467.11)	5000		A321		27084	
(75,573.69)	4000		B737-300		37240	
(56,680.26)	3000		B777-200		5642	
(37,786.84)	2000		Dash 8-300		2700	
(18,893.42)	1000		B717-200		37240	
-	0		Learjet 24D		1332	
			Cessna 441 Conquest2		3581	
(123,468.51)	6535		Cessna 150		1812	
			Comanche		2642	
Horizontal distance is referenced to the touchdown end of the runway (0,0).						
Vertical distance is elevation above ground level.						

APPENDIX F

Clark County Biogenic Emission Inventory Report

Biogenic Volatile Organic Compound Emission Inventory Improvement Project

Final Report

Prepared for the Clark County Division of Air Quality and Environmental Management

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Alex B. Guenther, Ph.D.
Maria R. Papiez

September 19, 2006

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1. Executive summary

In December, 2005 Clark County's Division of Air Quality and Environmental Management requested a review of their current biogenic volatile organic compound (VOC) emission inventory. This initial inventory was prepared by Environmental Quality Management (EQM) of Las Vegas, NV and is based on the Biogenic Emission Inventory System (BEIS) from the US EPA. The county was concerned with this inventory since it projected biogenic VOC emissions that were four times greater than anthropogenic emissions. After reviewing the report, Dr. Mark Potosnak of the Desert Research Institute and Dr. Alex Guenther of the National Center for Atmospheric Research presented a series of recommendations that would improve the current emissions inventory. Highlights of the recommendations included the need for Clark County-specific measurements and the adoption of the MEGAN (Model of Emissions of Gases and Aerosols from Nature) framework which has improved land cover characterization compared to BEIS.

During the summer of 2006, Dr. Potosnak and Ms. Maria Papiez carried out an extensive survey of biogenic VOC emissions from plants within Clark County. The species measured accounted for over 85% of the vegetative cover within the county. Compared to the estimates provided by the BEIS framework, measured emissions of biogenic VOCs were much lower. In addition, Ms. Papiez prepared a comparison of land cover data used in the original EQM emission inventory with the Southwest Regional Gap Analysis Project dataset (SWReGAP). Although overall land cover classification differences were minor, this analysis uncovered that the original BEIS estimates of vegetation density were too high for the arid lands of Clark County. Using satellite derived estimates of leaf area index (LAI) substantially reduces predicted emissions.

In parallel to this work, Dr. Guenther adapted the MEGAN framework for Clark County. The initial MEGAN inventories are based on SWReGAP data and satellite LAI, and include emissions factors measured in Clark County. An analysis of this revised inventory reveals substantial reductions in biogenic VOC emissions due to the new emissions estimates and more realistic vegetation densities provided by the satellite data. This revised emission inventory presents a significant improvement over the previous inventory by incorporating county-specific data and satellite derived biomass estimates.

2. Introduction

Biogenic VOC emissions from plants can have substantial impacts on regional air quality (Chameides et al. 1988). As with anthropogenic VOCs, biogenic VOCs react with oxidants in the atmosphere and then promote the production ozone via the action of nitrogen oxides (NOx). Biogenic VOC emissions can dominate anthropogenic VOC emissions in some areas and have been shown to increase the ozone production efficiency of NOx present in power plant plumes (Ryerson et al. 2001). Early research on biogenic VOC emissions focused on the heavily forested regions of the East Coast (Trainer et al. 1987), and later some attention was focused on California (Winer et al. 1992). Initial attempts at global modeling (Guenther et al. 1995) required estimates for all land cover types, including arid lands, but little data was available. For arid regions such as Clark County, only recently have measurements entered the literature (Geron et al. 2006). This lack of knowledge presents obvious difficulties for modeling the impact of biogenic VOCs on ozone concentration in the Clark County urban area. Understanding this impact is crucial, since the effectiveness of control strategies for reducing ozone by limiting anthropogenic VOC and NO_x emissions depends on it.

2.1. Initial assessment

After a review of the Clark County biogenic volatile organic compound (VOC) emissions inventory produced by EQM, three important items were identified that required improvement. (1) The current emissions inventory relies on plant-specific emissions factors from the BEIS3 (Biogenic Emissions Inventory System, version 3) modeling framework. For many of the desert species in Clark County, there are no BEIS3 emissions factors available. Therefore, a majority of the modeling domain is assigned to the generic “shrubgrass” category. (2) The current inventory uses the standard BEIS3 emission algorithms, which will likely need adjustment for desert plants. For example, many desert species are drought deciduous. Bursage (*Ambrosia dumosa*) is a significant species in Clark County and is physiologically inactive during the dry summer months, but the BEIS3 algorithms do not account for this dormancy. (3) Although the current survey work based on the land cover database from RECON is adequate, there are additional sources of land cover data available that would improve the biogenic emissions inventory. In particular, the current survey only determined plant spatial coverage, and did not consider plant foliar densities, which are necessary for estimating biogenic VOC emissions. Instead, the current inventory used default foliar densities from the BEIS3 modeling framework. Again, these species densities are not appropriate for desert ecosystems, and other sources of land cover data have better estimates of species densities. We propose to correct these shortcomings by (1) conducting measurements on the species that dominate biogenic VOC emissions in Clark County, (2) comparing the current land cover database with other currently available databases and (3) deploying a more comprehensive and adaptable biogenic emissions model: the Model of Emissions of Gases and Aerosols from Nature (MEGAN), developed at the National Center for Atmospheric Research in Boulder, CO.

2.2. Overall plan

Based on the initial assessment, the following plan was developed. Dr. Potosnak and Ms. Papiez would perform a literature survey to collect biogenic VOC emission factors from species that made up over 85 % of the land cover or projected emissions based on the BEIS emission inventory (Section 3). Ms. Papiez carried out a comparison of the land characterization data used in the EQM inventory and the new SWReGAP data (Section 3). Dr. Potosnak and Ms. Papiez would conduct biogenic VOC measurements on all species described above (Section 4). Dr. Guenther would provide a beta version of the emission inventory based on existing MEGAN defaults (see MEGAN user manual). Dr. Guenther would provide a final emission inventory based on MEGAN, measured emission factors, and species information from the previously completed EQM surveys. The results of these tasks are presented in this report. A detailed list of deliverables and results is show in the section 8.

3. Land cover comparison and literature review

3.1. Land cover comparison

An extensive comparison of the land cover classifications was accomplished using a graphical information system (GIS, Arcview). The initial biogenic VOC emission inventory performed by EQM was based on data from the RECON land cover characterization. The MEGAN framework is based on data from the SWReGAP project. Although different land cover categories are used in these databases, there is a strong correspondence between the categories. Most of the disagreement was found in categories that only occurred at higher elevations.

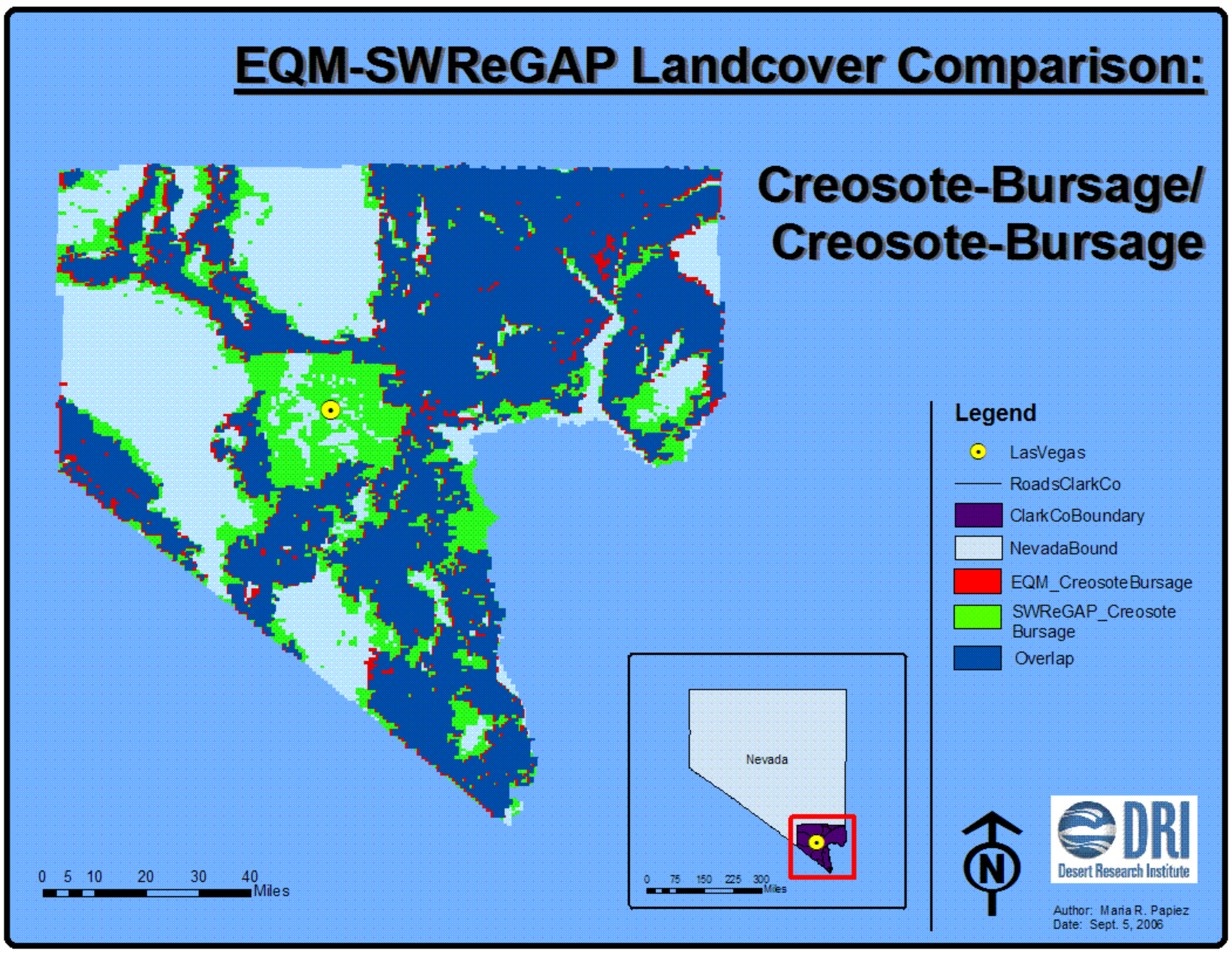

Figure 1 A comparison of the creosote-bursage category, which exists in both the SWReGAP and in the RECON dataset used by EQM. For this comparison, kilometer square grid cells were considered to be in the category if they contained more than 25 % coverage for that category.

Because of the small area of land cover types at high elevation, disagreements are not of significant importance. These detailed comparisons were presented at meeting with the Project Oversight Committee in July. Overall, there was good agreement between the major categories, and it was concluded that the selected land cover characterization scheme would not have a major impact on results. For example, the creosote-bursage category, which dominates the coverage of Clark County, occurs in both data sources. As seen in Figure 1, there is generally good agreement between these classification schemes. Note that the biggest discrepancy is located within the urban area. This might be due to different definitions of the categories. SWReGAP has only two urban classifications, while EQM/RECON had ten.

3.2. Literature review

Although the classification scheme would have little impact, MEGAN uses satellite-based LAI data to estimate biomass coverage. These biomass coverage estimates are much lower than used in the existing EQM/BEIS inventory, and these lower the emission inventory by a considerable amount. A literature review was also performed to gather emission estimates for the top 85 % of species present in Clark County. The species and associated references are listed below.

Species	Reference
Ambrosia	(Geron et al. 2006)
Artemesia	(Winer et al. 1983, Arey et al. 1995, Guenther et al. 1996b)
Atriplex	(Archer et al. 1994, Guenther et al. 1996b, Geron et al. 2006)
Creosote	(Geron et al. 2006)
Encelia	(Winer et al. 1983)
Ephedra	(Geron et al. 2006)
Eriogonum	(Winer et al. 1983)
Krameria	(Geron et al. 2006)
Opuntia	(Archer et al. 1994)

The combined effect of accounting for improvements in biomass characterization and the literature emission factors is substantial for both isoprene and monoterpene emissions. These factors were combined to create a new emission inventory based on the original EQM/BEIS framework. Although the county chose not to implement this intermediary inventory, the comparison with the original inventory shows the magnitude of the changes involved. Figure 2 details this impact for monoterpene emissions. Isoprene emissions showed little reduction or an increase, because one genus, *Ephedra* (Mormon tea), has a high isoprene emission rate in the literature (Geron et al. 2006) and occurs in many land cover types.

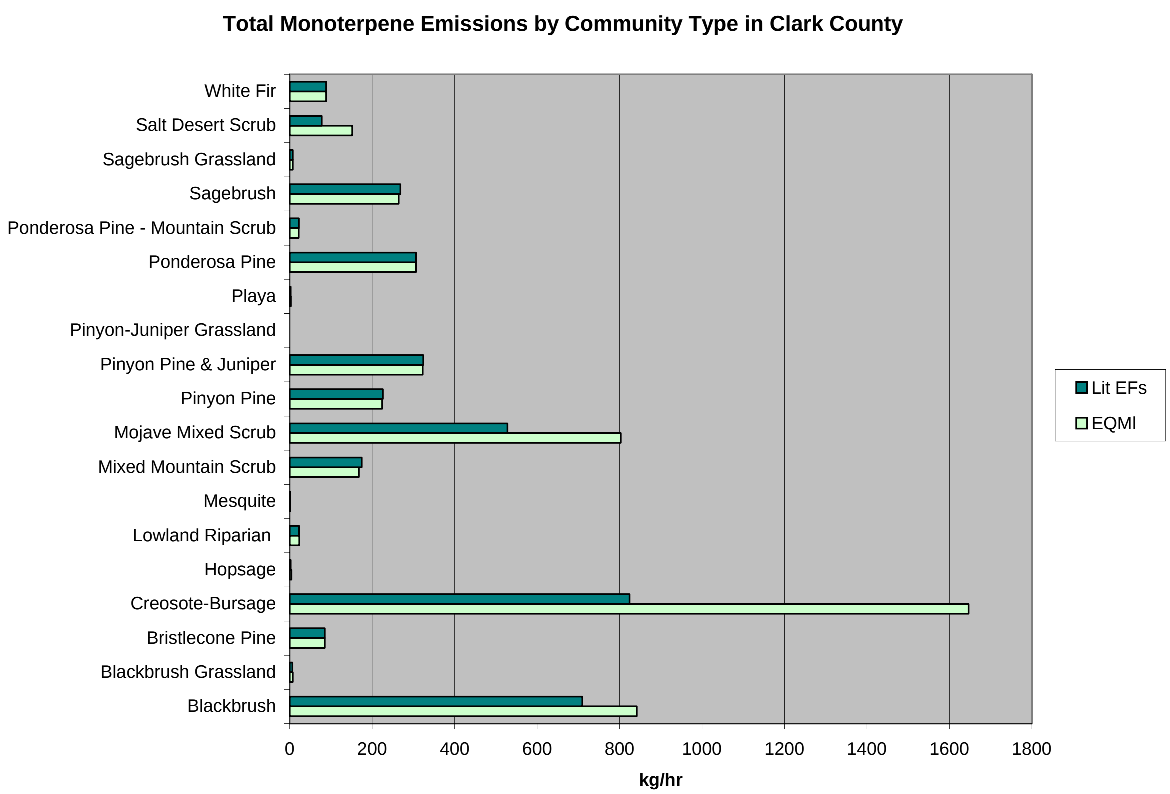

Figure 2 The effect of using literature values for plant emission factors (EFs) for monoterpene emissions and using new biomass estimates based on satellite LAI values.

4. Biogenic VOC measurements

Following the initial plan, an analysis of the previous EQM plant survey data and a review of the literature data were combined to identify plant species that accounted for 85% of land cover and 85% of biogenic VOC emissions (Table 1). Field measurements of plant biogenic emissions were carried out over four months (May—August). This allowed for repeated sampling of certain species.

Highest Emitters	Modified Highest Emitters	Highest Landcover
1.Oak	1.Oak	1.Creosote
2.Creosote	2.Ephedra	2.Ambrosia
3.Ambrosia	3.Ponderosa Pine	3.Grasses
4.Ponderosa Pine	4.Creosote	4.Blackbrush
5.Blackbrush	5.Ambrosia	5.Saltbush
6.Grasses	6.Blackbrush	6.Ephedra
7.Saltbush	7.Grasses	7.Juniper
8.Pinyon Pine	8.Pinyon Pine	8.Sage
9.Juniper	9.Juniper	9.Krameria
10.Ephedra	10.Saltbush	10.Pinyon
11.Sage	11.Sage	11.Yucca
12.Krameria	12.White Fir	12.Eriogonum
13.White Fir	13.Cottonwood	13.Cacti
14.Cacti	14.Acacia	14.Brittlebush
15.Cottonwood	15.Yucca	15.Oak
16.Acacia	16.Hopsage	
85.5% of total CC BVOCs	**84.8% of total CC BVOCs**	**46.9% (85% of non-barren or impervious land in CC)**

Table 1 Listing of the target species for this report. The names follow the conventions used in the EQM report. The "Highest Emitters" category is based on the EQM inventory, and the "Modified Highest Emitters" is the list based on literature values as detailed in section 3.2.

4.1. Methodology

A unique field-portable biogenic VOC sampling system that was specifically designed to measure arid species was employed for this project. This system is part of the equipment available at the Atmosphere-Biosphere Interactions laboratory of the Desert Research Institute. Quantification of biogenic VOCs was conducted with a field portable gas chromatograph and a flame ionization detector (GC/FID model 8610, SRI Instruments, Torrance, CA). VOCs were concentrated onto a solid absorbent (Tenax TA, Supelco, Bellefonte, PA) from 1 l of air (a flow rate of 50 standard cm^3 sec^{-1} for 20 minutes, as determined by an Aalborg mass flow controller), and then thermally desorbed at 275 °C for injection into the GC. The solid absorbent was contained in an 1/8″ OD silicon-treated tube and cooled with thermoelectric coolers. The GC has an Mtx-624 column (30 m length, 0.53 mm ID), and the temperature program was 2 minutes at 50 °C, 17.5 minutes ramping at 10 °C/min, and finally 5.5 minutes at 225 °C. This setup was able to quantify isoprene (C_5H_8), monoterpenes ($C_{10}H_{16}$) and sesquiterpenes ($C_{15}H_{24}$). The sesquiterpene measurements were an extension of the project funded by the Desert Research Institute and Guinn fellowship awarded to University of Nevada, Reno graduate student Maria Papiez. The results of these additional measurements will be reported by Ms. Papiez in her master's thesis (anticipated completion: December 2006). Plants were enclosed in a glass chamber (approximately 1.5 l volume) which contained a thermocouple to measure leaf temperature. Glass was selected since it is very inert for reactive compounds such as sesquiterpenes. Zero air for the system was provided by a Licor leaf gas exchange system (LI-6400, Licor Inc., Lincoln, NE) and two scrubbers were used to remove incoming hydrocarbons and ozone. The first larger scrubber contained granulated charcoal, and a second smaller scrubber used coconut charcoal. The second scrubber was disposable and replaced daily. The incoming gas flow rate was determined by the leaf gas exchange system, and was always set to 730 standard cm^3 min^{-1}. Biomass enclosed by the chamber was collected, and then dried and weighed in the laboratory for determining dry leaf weights.

Overall, one hour was necessary to perform one measurement: 20 minutes of collection time, 30 minutes of analysis time, and a 10 minute period to allow the GC to cool down. All measurements were repeated to minimize the effects of disturbance, and blank runs (no plant material in the chamber) performed at least twice per day. Professional judgment was used to assess repeated measurements for disturbance effects. Most importantly, care was taken in leaf chamber placement around branches and leaves. With these limitations, three individual plants could be measured in one day.

The plant samples enclosed in the glass chamber employed in the study were subjected to ambient light and ambient temperature. The chamber did have a thermal regulation system composed of two thermoelectric coolers, and these coolers could offset any heating due to solar forcing within the glass chamber. Ambient light was measured with a light sensor built into the leaf gas exchange system (LI-190, Licor Inc., Lincoln, NE). Leaf temperature was measured with a fine-wire thermocouple. For each species measured, light dependence of BVOC emissions was either measured directly or determined from the literature. If a species was light dependent, then emission factors were scaled to 30 °C using an exponential relationship, measured leaf temperature (T_{leaf}, in K) and a β factor of 0.09 according to the following equation:

$$EF = \frac{Emission}{\exp(\beta(T_{leaf} - 303))}$$

If emissions were determined to be light dependent, then both a more complicated temperature algorithm was applied and emissions were also scaled with light. These algorithms are employed in MEGAN, and therefore we applied the same algorithms to our data. The first light dependent emission algorithm determines a correction factor for temperature (C_T) which accounts for the previous month's temperature (T_{mon} in K), which was determined from measurements at McCarran International Airport. Since MEGAN will adjust emission factors based on monthly temperatures, it is necessary to adjust measured values. The following equations determine the correction factor:

$$T_{opt} = (313 + (0.6 \times (T_{mon} - 297)))$$

$$x = \frac{\frac{1}{T_{opt}} - \frac{1}{T_m}}{0.00831}$$

$$E_{opt} = 1.75 \times \exp(0.08 \times (T_{mon} - 297))$$

$$C_T = \frac{E_{opt} \times 200 \times \exp(80 \times x)}{200 - 80 \times (1 - \exp(200 \times x))}$$

The second algorithm corrects for light (*PAR* in μmol m^{-2} s^{-1}) dependence (C_L) in MEGAN:

$$C_L = \frac{0.0027 \times 1.066 \times PAR}{\sqrt{1 + (0.0027 \times PAR)^2}}$$

The final emission factor for light dependent BVOCs is then calculated as:

$$EF = \frac{Emission}{C_T \times C_L}$$

Calibration protocols are discussed in section 7. Identification of compounds was performed several ways. First, an authentic standard containing isoprene and α-pinene was used to determine the elution times of these compounds, and it was assumed that other monoterpenes had a similar response factor. Other compound elution times were determined by collecting samples in the field onto either a solid absorbent (SuperQ) or using solid-phase micro extraction (SPME). Samples were then analyzed on a gas chromatograph/mass spectrometer (GC/MS) after returning samples to the laboratory. The same column was used in the GC/MS as in the field portable GC, so retention times could be compared. Compound identification was accomplished with comparison to mass spectral libraries.

4.2. Research sites

Field sites were selected to meet multiple goals. First, the presence of multiple plant species was extremely important, since the sampling equipment took approximately one hour of setup time each day. If species were located within a reasonable distance (< 500 meters), then the equipment could be moved and multiple individual plants could be measured in one day. Second, a local knowledgeable expert on plant identification was desirable. This was particularly important for identifying species within the urban areas. Finally, sites were selected that were deemed to be representative of typical growing conditions for the species of interest.

4.2.1. Angel Park Golf Course

Angel Park is located in northwest Las Vegas, just south of the Summerlin community. The course contains a wide variety of vegetation, although it is dominated by grass species. Biogenic emissions from species of mesquite, cottonwood, shoestring acacia, and creosote bush were measured at this location.

4.2.2. Sunset Park

Sunset Park is located just east of McCarran International Airport in Las Vegas. It is one of the largest parks in the city and contains baseball fields, volleyball courts, a swimming pool and open space. Biogenic emissions from species of saltbush, mesquite, Arizona Ash, Mondel and Aleppo Pine, oleander, palm, mulberry, and barometerbush were measured at this location.

4.2.3. Deerbrooke Residential Neighborhood

The Deerbrooke neighborhood is located in northwest Las Vegas, just west of Highway 95. It is a typical suburban neighborhood with lot sizes ranging from quarter-acre to half-acre. Biogenic emissions from species of juniper, rosemary, and palm were measured at this location.

4.2.4. Desert Research Institute

DRI is located just east of Las Vegas Blvd. on Flamingo Road. The vegetation on the grounds was chosen with water conservation in mind and therefore, many drought-tolerant (xeriscape) native and non-native species were used in landscaping. Biogenic emissions from shoestring acacia, desert willow, and saguaro cactus were measured at this location.

4.2.5. Clark County Complex

The Clark County government buildings are located near the intersection of Interstate 15 and Highway 95. This location utilizes xeriscape vegetation, but also includes some large grassed areas. Biogenic emissions from species of mesquite and Mondel Pine were measured at this location.

4.2.6. Nevada Desert FACE Facility (NDFF)

NDFF is located on the grounds of the Nevada Test Site just north of Mercury, NV. This branch of the FACE network is setup to examine the effects of elevated carbon dioxide on desert ecosystems. This site was visited to determine biogenic emissions from creosote bush in a native setting.

4.2.7. Mount Charleston Wilderness Area

Mount Charleston is located in the Spring Mountain range northwest of Las Vegas. Climbing to an elevation of almost 12,000 feet, a number of different landcover types cover this wilderness and a large variety of vegetation is present. Measurements of biogenic emissions from pinyon pine, yucca, juniper, cliffrose, oak, blackbrush, and mountain mahogany were taken in this area.

Name	Geographic Location	Latitude/Longitude
Angel Park Golf Course	241 South Rampart Blvd., Las Vegas, NV 89145	36° 10' 20.49" N, 115° 17' 13.56" W
Sunset Park	SE corner, intersection of Sunset Rd. & Eastern Ave., Las Vegas, NV 89120	36° 04' 16.80" N, 115° 07' 06.24" W
Deerbrooke neighborhood	Intersection of Craig Rd. & Buffalo Dr., Las Vegas, NV 89129	36° 14' 26.77" N, 115° 15' 36.36" W
Desert Research Institute	755 E. Flamingo Rd., Las Vegas, NV 89119	36° 06' 52.23" N, 115° 08' 49.53" W
Clark County Complex	500 S. Grand Central Pkwy, Las Vegas, NV 89155	36° 09' 59.53" N, 115° 09' 18.39" W
Nevada Desert Face Facility	Mercury, NV, 60mi. NW of Las Vegas, NV	36° 45' 20" N, 115° 59' 15" W
Mt. Charleston Wilderness	Spring Mtns., 35 mi. WNW Las Vegas, NV (2 locations on an elevation gradient)	36° 16' 39" N, 115° 30' 21" W 36° 16' 24" N, 115° 35' 01" W

Table 2 Location of the research sites used in the present study.

4.3. Measurement results

Results from our measurements are summarized in Table 3 below. Additional species were collected in the urban areas and are available upon request, but these species are not included in the top 85 % of coverage of the county, and are therefore omitted from this report.

Species	***Light Dependent?***	***Isoprene***	***α-pinene***	***Camphene***	***Sabiene β-pinene***	***3-carene***	***Other* MTs***	***Total MTs***
Larrea tridentata	N	0.00	0.01	0.04	0.00	0.00	0.11	0.16
Coleogyne ramosissima	N	0.24	0.13	0.07	0.00	0.00	1.99	2.43
Atriplex sp.	N	0.00	0.00	0.00	0.00	0.00	0.30	0.30
Juniperus ssp.	Y	0.00	0.17	0.02	0.05	0.23	0.07	0.54
Pinus monophylla	N	0.00	0.00	1.65	0.05	0.15	0.08	1.93
Yucca sp.	N	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Carnegiea gigantean	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Artemisia tridentate	N	0.03	0.12	0.13	0.19	0.00	2.62	3.05
Purshia Mexicana	N	0.62	10.72	0.00	1.06	0.23	3.37	15.37
Cercocarpus montanus	Y	0.09	0.00	0.00	0.00	0.00	0.89	0.88
Quercus gambelii	Y	27.38	0.00	0.00	0.00	0.00	0.01	0.01

Table 3 Emission factors measured in Clark County for the primary species selected for study. Units are μg C gdw^{-1} hr^{-1}. The category "Other MTs" includes unidentified monoterpenes and some oxygenated monoterpenes. Values are normalized to 30 °C and 1000 μmol m^{-2} s^{-1}.

Of particular interest is the result that few of the species measured in Clark County are isoprene emitters. This is compared to results from Maricopa County (cf. Table 5 and Table 7) where isoprene emitters were found in typical abundances.

Species	***Number of samples***	***Isoprene***	***α-pinene***	***Camphene***	***Sabiene β-pinene***	***3-carene***	***Other* MTs***	***Total MTs***
Larrea tridentata	11	0.00	0.02	0.04	0.00	0.00	0.12	0.16
Coleogyne ramosissima	2	0.00	0.04	0.03	0.10	0.00	1.24	0.71
Atriplex sp.	4	0.00	0.00	0.00	0.00	0.00	0.20	0.20
Juniperus ssp.	5	0.00	0.08	0.01	0.02	0.15	0.03	0.26
Pinus monophylla	2	0.00	0.00	1.80	0.07	0.15	0.09	2.12
Yucca sp.	1	NA	NA	NA	NA	NA	NA	NA
Carnegiea gigantea	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Artemisia tridentata	6	0.07	0.04	0.04	0.06	0.00	0.98	0.79
Purshia mexicana	2	0.36	5.94	0.00	0.52	0.11	1.73	8.29

Species	Number of samples	Isoprene	α-pinene	Camphene	Sabiene β-pinene	3-carene	Other* MTs	Total MTs
Cercocarpus montanus	2	0.12	0.00	0.00	0.00	0.00	0.90	0.90
Quercus gambelii	2	0.75	0.00	0.00	0.00	0.00	0.01	0.01

Table 4 Emission factor standard deviations for the same data as **Table 3**.

Standard deviation data is reported in Table 4. As can be seen by comparing to Table 3, measurement errors for most species was considerable for some species. And because some measurements were repeats on the same individual, this error rate is more indicative of the analytical precision of the equipment, and as discussed in section 5, there are many more sources of variability when determining species emission factors. For example, biogenic emission capacities for individual leaves are known to vary based on light environment (Harley et al. 1996), growth temperatures (Monson et al. 1992), canopy position (Harley et al. 1996), nutrient availability (Harley et al. 1994) and carbon dioxide concentration (Rosenstiel et al. 2003).

Species	Light Dependent?	Isoprene	α-pinene	Camphene	Sabiene β-pinene	3-carene	Other* MTs	Total MTs
Ambrosia deltoidea	N	0.00	0.00	0.00	0.03	0.00	0.21	0.25
Encelia farinosa	N	0.00	1.40	0.01	0.61	0.07	0.72	2.80
Ephedra viridis	Y	5.32	0.00	0.00	0.00	0.00	0.00	0.00
Olneya tesota	Y	59.82	0.00	0.00	0.00	0.00	0.00	0.00
Simmondsia chinensis	Y	29.90	0.00	0.00	0.00	0.00	0.07	0.07
Juniperus ssp.	Y	0.00	0.16	0.00	0.14	0.01	0.07	0.38
Larrea tridentata	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parkinsonia microphylla	Y	0.00	0.00	0.00	0.00	0.00	0.09	0.09
Pinus monophylla	N	0.00	0.05	0.00	0.00	0.00	0.00	0.05
Atriplex canescens	N	0.00	0.00	0.00	0.00	0.06	0.00	0.06
Yucca sp.	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5 Emission factors measured in Maricopa County. Units are μg C gdw^{-1} hr^{-1}. Values are normalized to 30 °C and 1000 μmol m^{-2} s^{-1}.

Emission factors are also reported for measurements conducted by Dr. Potosnak in Maricopa County, since some species exist in both locations. These measurements are in addition to measurements performed by Dr. Brad Baker for the Maricopa County study and that are reported in Table 7.

Species	*Number of samples*	*Isoprene*	*α-pinene*	*Camphene*	*Sabiene β-pinene*	*3-carene*	*Other* MTs*	*Total MTs*
Ambrosia deltoidea	3	0.00	0.00	0.00	0.03	0.00	0.07	0.07
Encelia farinosa	4	0.00	0.44	0.03	0.43	0.05	0.29	0.94
Ephedra viridis	1	NA	NA	NA	NA	NA	NA	NA
Olneya tesota	2	1.51	0.00	0.00	0.00	0.00	0.00	0.00
Simmondsia chinensis	2	4.60	0.00	0.00	0.00	0.00	0.00	0.00
Juniperus ssp.	4	0.00	0.11	0.01	0.13	0.01	0.05	0.28
Larrea tridentata	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Parkinsonia microphylla	12	0.00	0.00	0.00	0.00	0.00	0.19	0.15
Pinus monophylla	1	NA	NA	NA	NA	NA	NA	NA
Atriplex canescens	2	0.00	0.00	0.00	0.00	0.09	0.00	0.09
Yucca sp.	1	NA	NA	NA	NA	NA	NA	NA

Table 6 Emission factor standard deviations for the same data as Table 5.

4.3.1. Seasonality

As stated in the initial assessment (2.1), a goal of the current study was understand the influence of seasonality on BVOC emissions. Because creosote bush is a dominant species in the natural lands of Clark County, a majority of the effort was devoted to this species. But observed emission factors were consistently small (Table 3), and therefore no strong seasonal pattern emerged. There appeared to be a correlation between emissions and flowering (data not shown), but the relationship requires further study. Developing an algorithm to predict flowering would be difficult, since flower phenology depends strongly on climate and elevation.

5. Modeling

MEGAN driving variables that were revised for this project include land cover distributions, landscape average biogenic emission factors, plant functional type (PFT) cover fractions and Leaf Area Index.

5.1. Land cover distributions

The spatial distribution of land cover for most of the US is based on regional SWReGAP data (ftp://ftp.gap.uidaho.edu/products/regional). Urban areas in Clark County were revised using Clark county land-use geographical information. Land cover distributions in Mexico are characterized using the Olson et al. (2001) global ecoregion database.

5.2. Landscape average biogenic voc emission factors

Landscape average emission factors are determined from species specific emission factors and plant species composition estimates for each land cover types. Isoprene and monoterpene emission rate measurements conducted during summer 2006 characterized the dominant Clark County plant species in both wildland and urban landscapes. The field study results are shown in Table 3 along with literature emission rates for important Clark County plant species (Table 7). Measurements were made on all of the dominant plant species as well as many other common Clark County plant species. Many of the plant species examined during the summer 2006 had not previously been studied or had been characterized by only one or two measurements. A more detailed description of the methods and results will be published in a peer reviewed journal. Note that the emission rates reported by different studies can differ substantially. These differences may be due to within-species genetic variability or phenological and physiological variations. They could also be due to measurement errors or artificial disturbances associated with enclosure measurement techniques. We have used the approach of

Guenther et al. (1994), which considers the quantity and quality of the emission rate data, to integrate these observations and determine the MEGAN emission factors.

The 1997 USDA NASS crop statistics were used to quantify crop species composition in U.S. counties. Species composition for Clark County urban land cover types are based on the EQM land cover survey. The plant species composition of most US wildland landscapes is based on USDA FIA data for trees and NRCS data for shrubs and grass. The major land cover types are characterized by hundreds of FIA and NRCS plots. Species composition for some southwestern U.S. land cover types were revised based on the results of the EQM land cover surveys in Clark County and recent land cover surveys in Maricopa County. The plant species composition for land cover types in Mexico were based on descriptions provided in the Olson et al. (2001) global ecoregion database.

5.3. Plant Functional Type cover and Leaf Area Index

MODIS satellite observations were used to characterize PFT cover fractions and monthly LAI for agricultural landscapes and most wildland landscape types. Urban land cover PFT and LAI for Clark County were based on the results of the EQM land cover surveys in Clark County and additional surveys in Maricopa County, Arizona.

Analysis of field observations revealed that the MODIS based land cover estimates considerably underestimate vegetation cover in sparsely vegetated wildland landscapes within Clark County and other regions in the U.S. southwest. Based on the field study observations, a lower limit of 20% shrub and grass cover and an LAI of 0.5 (which results in an average LAI of 0.1) were used for all landscapes except for water and barren categories.

Reference[1]	Common Name	species	Iso-prene	α-pinene	β-pinene	cam-phene	myrcene	limo-nene	3-carene	g-terpinene	Other MT	Total MT
(Arey et al. 1995)	chamise	Adenostoma fasciculatum	0									0
(Arey et al. 1995)	manzanita	Arctostaphylos	0									0
(Arey et al. 1995)	California sagebrush	Artemisia californica	0									47
(Arey et al. 1995)	greenbark	Ceanothus spinosus	0									1.8
(Arey et al. 1995)	mountain mahogany	Cercocarpus betuloides	0									0
(Arey et al. 1995)	Black sage	Salvia mellifera	0									5
(Geron et al. 2006)		Ambrosia deltoidea	0	0.06	0.31	0.51	2.3	1	Not reported	Not reported	Not reported	4.1
(Geron et al. 2006)		Ambrosia dumosa	0	1.6	3	0.06	1.1	2	Not reported	Not reported	Not reported	7.9
(Geron et al. 2006)		Atriplex canescens	0	0	0	0.17	0.13	0	Not reported	Not reported	Not reported	0.31
(Geron et al. 2006)		Chrysothamnus nauseosus	0	0.28	0	0	0.16	0.21	Not reported	Not reported	Not reported	0.65
(Geron et al. 2006)		Ephedra nevadensis	10	0.05	0.03	0.01	0.09	0.11	Not reported	Not reported	Not reported	0.3
(Geron et al. 2006)		Hymenoclea salsola	0	1.4	0.06	0.02	0.35	0.3	Not reported	Not reported	Not reported	2.6
(Geron et al. 2006)		Krameria eracta	0	0.02	0.06	0.03	0.14	0.05	Not reported	Not reported	Not reported	0.3
(Geron et al. 2006)		Larrea tridentata	0	0.37	0.12	0.44	0.3	0.74	Not reported	Not reported	Not reported	2
(Geron et al. 2006)		Lycium andersonii	0	0.1	0.27	0.11	0.39	0.27	Not reported	Not reported	Not reported	1.1
(Geron et al. 2006)		Olneya tesota	~25	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported
(Geron et al. 2006)		Psorothamnus fremontii	35	0.5	0	0	1	0.5	Not reported	Not reported	Not reported	2
(Guenther et al. 1999)	Acacia	Acacia greggii	0	0	0	0	0	0	0	0	0	0
(Helmig et al. 1999)	serviceberry	Amelanchier alnifolia	0	0	0	0	0	0	0	0	0	0
(Helmig et al. 1999)	sagebrush	Artemisia tridentata	0	0.2		0.5	0	0	0	0	9.2	9.9
(Helmig et al. 1999)	saltbush	Atriplex canescens	0	15	1.3	0.7	0.2	2.2			7	26.4

Reference[1]	Common Name	species	Iso-prene	α-pinene	β-pinene	cam-phene	myrcene	limo-nene	3-carene	g-terpinene	Other MT	Total MT
(Helmig et al. 1999)	mountian mahogany	Cercocarpus montanus	0	0	0	0	0	0	0	0	0	0
(Helmig et al. 1999)	rabbitbrush	Chrysothamnus nauseosus	0	15	1.7	2.3	1.6	39	0	2.9	18	80.5
(Helmig et al. 1999)	snowberry	Symphoricarpos occidentalis	0	0	0	0	0	0	0	0	0	0
(Knowlton et al. 1999)	Saltbrush	Atriplex	0	0.02	0.01	0	0.03	0.01	0.01	Not reported	Not reported	0.08
(Knowlton et al. 1999)	juniper	Juniperus	0	3.1	0.03	0.02	0.04	0.09	0.002	Not reported	Not reported	3.28
(Knowlton et al. 1999)	creosote	Larrea	0	0.1	0.06	0.04	0.09	0.09	0.08	Not reported	Not reported	0.46
(Knowlton et al. 1999)	mesquite	Prosopis	0	0.05	0	0	0.04	0.02	0	Not reported	Not reported	0.11
(Knowlton et al. 1999)	Oak	Quercus	26	0.02	0.03	0	0	0.02	0.01	Not reported	Not reported	0.08
(Knowlton et al. 1999)	sumac	Rhus	0	1.2	0.04	0.07	0	0	0	Not reported	Not reported	1.3
(Knowlton et al. 1999)	salt cedar	Tamarix	0	0	0.05	0.15	0.19	0	0.09	Not reported	Not reported	0.48
SAC-Maricopa		Acacia erioloba	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Ambrosia deltoidea	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Aristida longistea	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Atriplex canescens	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Brachychiton populneus	0.052	0.14	0	Not reported	0.038	0.02	0.003	Not reported	0.06	0.26
SAC-Maricopa		Brachychiton rupestris	0.03	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Buddleja marrubifola	0.42	0.079	0	Not reported	0	0	0	Not reported	0.39	0.47
SAC-Maricopa		Caesalpinia pulcherrima	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Caliandra eriophylla	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Carnegiea gigantea	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Chilopsis linearis	0	0	0	Not reported	0	0	0	Not reported	0	0

Reference[1]	Common Name	species	Iso-prene	α-pinene	β-pinene	cam-phene	myrcene	limo-nene	3-carene	g-terpinene	Other MT	Total MT
SAC-Maricopa		Cylindropuntia acanthocarpa	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Encelia farinosa	0	35	0.62	Not reported	0	0.2	0	Not reported	0.43	37
SAC-Maricopa		Ephedra nevadensis	46	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Fouquieria splendens	0.44	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Gleditsia triacanthos	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Juniperus osteosperma	0.044	1.7	0.52	Not reported	0.32	0.34	0	Not reported	0.49	3.4
SAC-Maricopa		Leucophyllum zygophyllum	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Mahonia fremontii	6.5	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Muhlenbergia lindheimeri	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Nerium oleander	1.2	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Olea europaea	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Olneya tesota	22	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		ornamental shrub	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Parkinsonia floridum	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Parkinsonia microphyllum	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Parkinsonia praecox	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Pinus monophylla	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Platanus wrightii	0.38	0.11	0	Not reported	0	0.19	0	Not reported	0	0.3
SAC-Maricopa		Proposis velutina	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Prosopis pubesens	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Quercus arizonica	8.4	0	0	Not reported	0	0	0	Not reported	0	0

Reference[1]	Common Name	species	Iso-prene	α-pinene	β-pinene	cam-phene	myrcene	limo-nene	3-carene	g-terpinene	Other MT	Total MT
SAC-Maricopa		Quercus buckleyi	11	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Quercus fusifornis	79	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Quercus suber	5.3	0.84	0.53	Not reported	0.11	0.14	0	Not reported	0.42	2.1
SAC-Maricopa		Salix gooddingii	15	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Sapium sebiferum	0	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Senna nemophila	0.052	0	0	Not reported	0	0.01	0	Not reported	0.021	0.031
SAC-Maricopa		Simmondsia chinensis	30	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Sophora secundiflora	19	0	0	Not reported	0	0	0	Not reported	0	0
SAC-Maricopa		Ungnadia speciosa	0.29	0	0	Not reported	0.27	15	0	Not reported	16	31.
Winer82		Encelia										6

Table 7 Emission rates (μg g^{-1} dry weight h^{-1}) for selected Clark and Maricopa County plant species determined during the June 2006 field study and comparison with other reported measurements. [1]The SAC-Maricopa measurements were conducted by Dr. Brad Baker and colleagues in Maricopa County, Arizona.

6. Emission inventory comparison

Two versions of the biogenic emission inventories are compared here. The first inventory was provided by Zheng Li at Clark County, and is based on the original EQM/BEIS inventory. The second inventory was produced for this contract by Dr. Guenther. Both inventories are based on MM5 model-simulated meteorological data. In addition to the new MEGAN modeling framework and the new emission factors, the MM5 data provided to Dr. Guenther has also changed since the original EQM/BEIS inventory. So, the emission comparisons presented below account for both changes in the biogenic emission inventory framework and differences in meteorological conditions as represented by the MM5 data.

Emissions produced in the MEGAN framework are much lower than the original EQM/BEIS inventory. As shown in Table 8, there are substantial reductions in most categories, but the reductions do depend on the selected grid. This is because the larger grids (e.g., 12 and 36 km) account from relatively large areas, and the two modeling frameworks treat some land cover types quite differently.

Grid	NO	ALD2	CO	ETH	FORM	ISOP	NR	OLE	PAR	TERPB	TOL	XYL
MEGAN												
1.3	32	43	186	34	6	217	229	56	465	22	0	0
4	203	278	1254	227	38	1548	1530	366	2997	141	1	2
12	2479	12327	34763	7365	1128	44062	46526	16801	129844	7233	40	76
36	5552	22909	70879	14964	2226	93871	93558	31288	253851	13047	88	159
BEIS												
1.3	40	164	658	101	88	273	389	383	2568	106	32	0
4	173	1751	5994	904	799	2628	3475	3423	23895	1236	282	0
12	4075	34108	92336	13870	12309	78025	53346	77911	459998	26943	4324	79
36	14614	64347	185735	27890	24761	150238	107248	145800	869052	49491	8688	179
Reduction (%)												
1.3	20	74	72	66	93	20	41	85	82	79	100	-562
4	-17	84	79	75	95	41	56	89	87	89	100	-519
12	39	64	62	47	91	44	13	78	72	73	99	3
36	62	64	62	46	91	38	13	79	71	74	99	11

Table 8 Comparison of emissions from the new MEGAN framework and the previous EQM/BEIS framework. The emissions are summed across the entire domains and across 25 hours (day of year 178, GMT). The domains have the grid spacing has indicated in the first column (km). The chemical species labels are as done in CBIV. The large

negative values under XYL are due to looking at differences between small numbers. The units are moles per second. Complete tables including total VOCs are given in section 9. Reduction percentages are calculated as (BEIS-MEGAN)/BEIS * 100%.

There are also large differences in the spatial pattern of emissions. The following figures show differences for one hour of the model run (4:00 p.m., Pacific Standard Time) which is the time of maximum emission for isoprene (ISOP). The data is again for day 178.

Figure 3 and Figure 4 compare the two inventories for the 1.3 km grid domain, which mostly includes Clark County. Several differences are evident. First, maximum emissions have shifted from the mountainous regions to the urban areas. The EQM/BEIS framework used unrealistically high biomass densities, and these were concentrated in the mountainous areas. The MEGAN framework overcomes this limitation by incorporating satellite derived estimates for LAI. On the other hand, EQM/BEIS had few emission estimates for urban vegetation, while MEGAN more properly accounts for this. Second, both figures use the same scale, and the overall decrease in the MEGAN inventory is highlighted by the lack of dark shading throughout the domain.

Figure 5 and Figure 6 compare the two inventories for the 36 km grid domain. Because most of this land is outside of Clark County, neither the EQM nor the present study has contributed to these inventories. Instead, this is primarily a comparison of BEIS with the new MEGAN framework. In this case, the spatial pattern of emissions is quite similar, but again the overall emissions are much lower in the case of the new MEGAN framework.

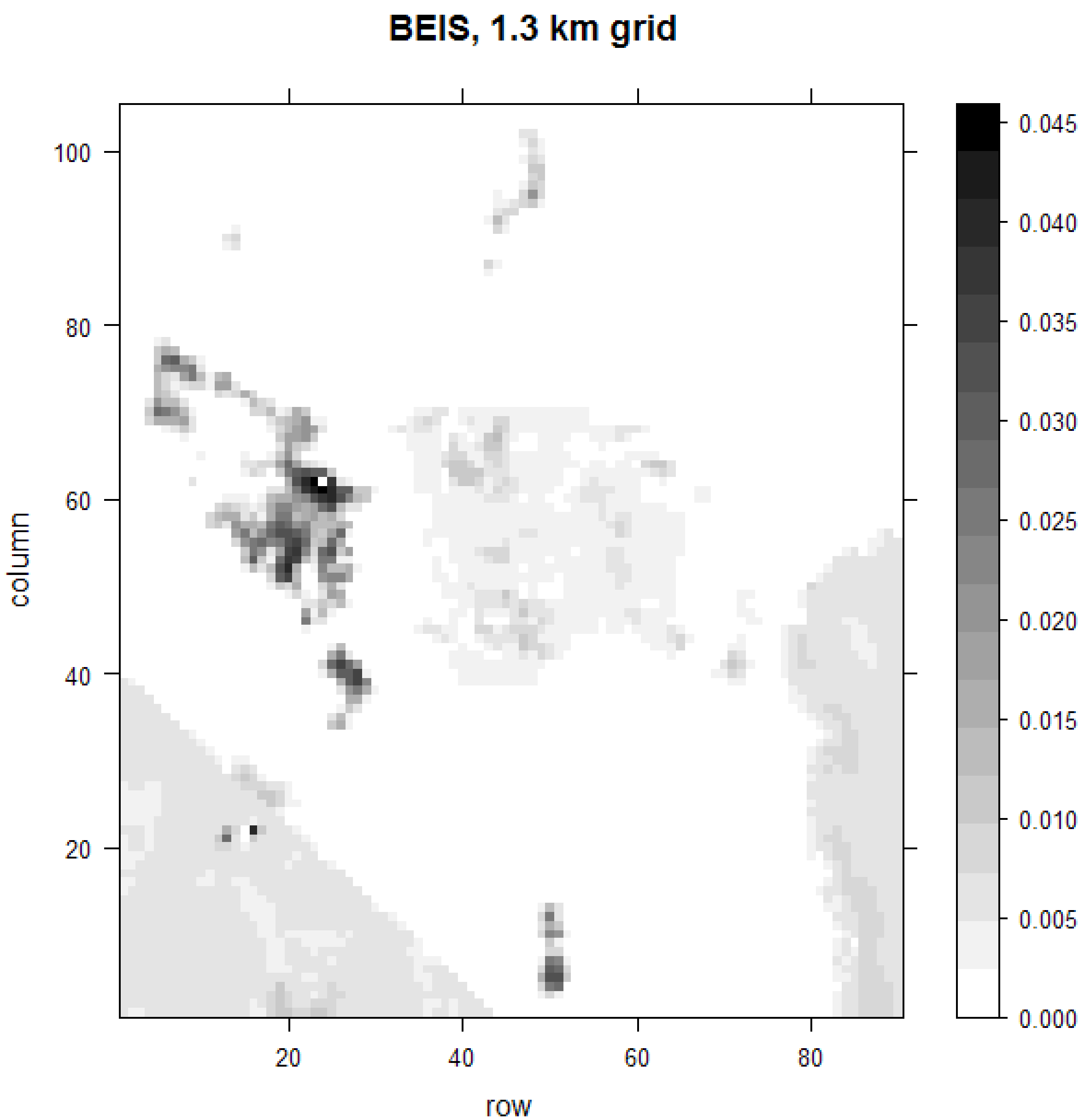

Figure 3 Isoprene emissions as predicted by the original EQM/BEIS model for 4:00 p.m. PST on day 178 for the 1.3 km grid.

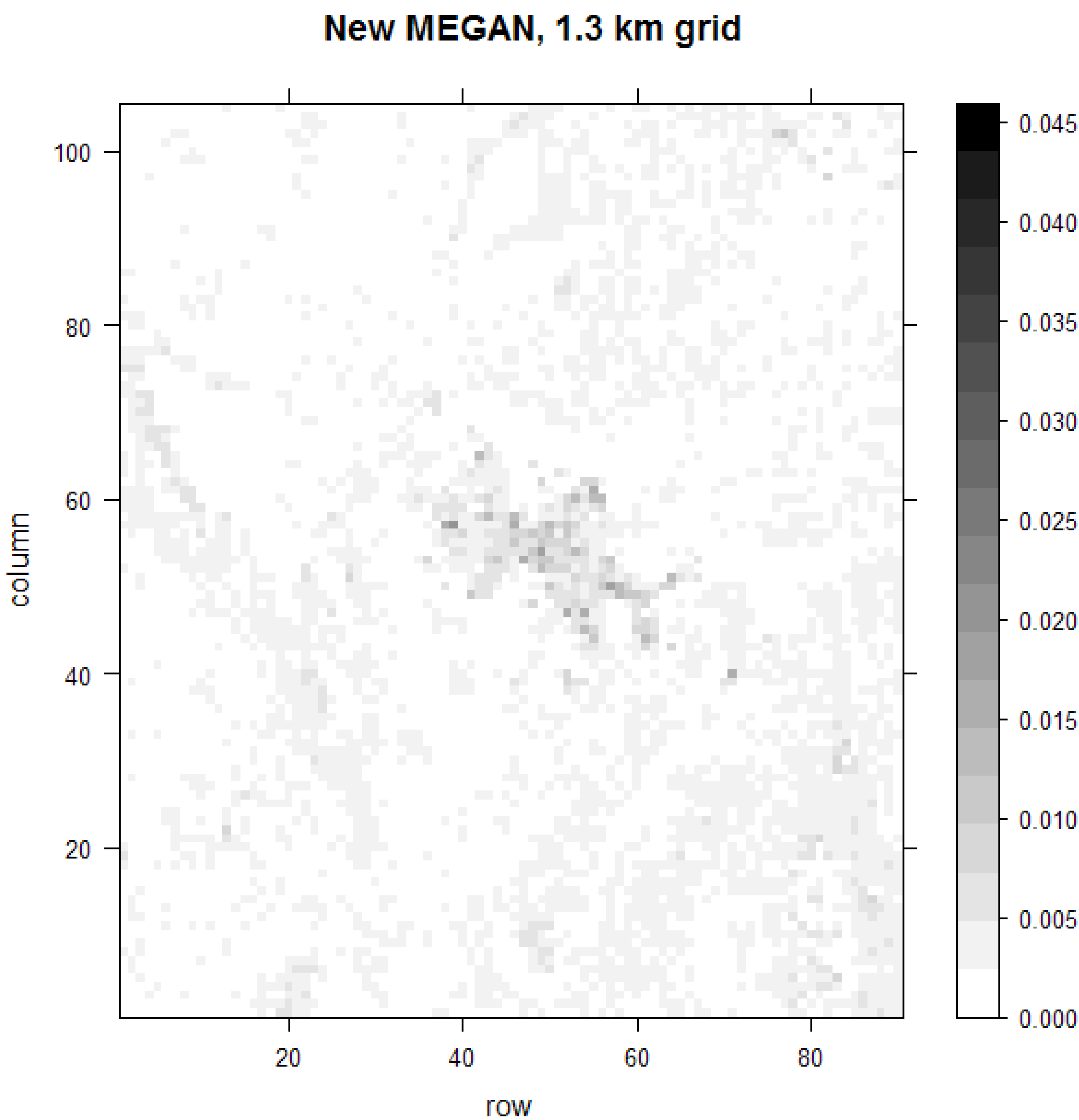

Figure 4 Isoprene emissions as predicted by the new MEGAN model for 4:00 p.m. PST on day 178 for the 1.3 km grid.

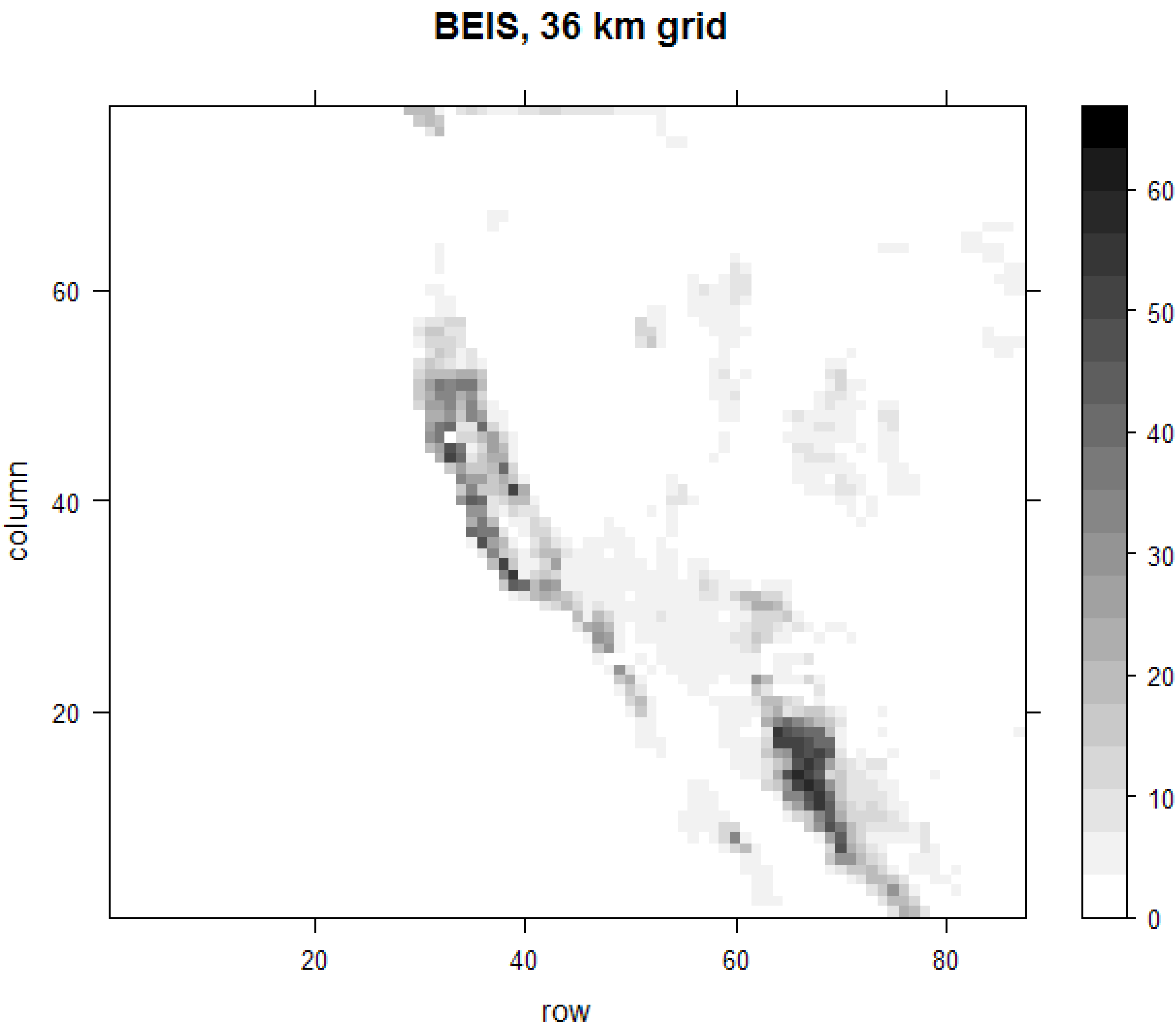

Figure 5 Isoprene emissions as predicted by the original EQM/BEIS model for 4:00 p.m. PST on day 178 for the 36 km grid.

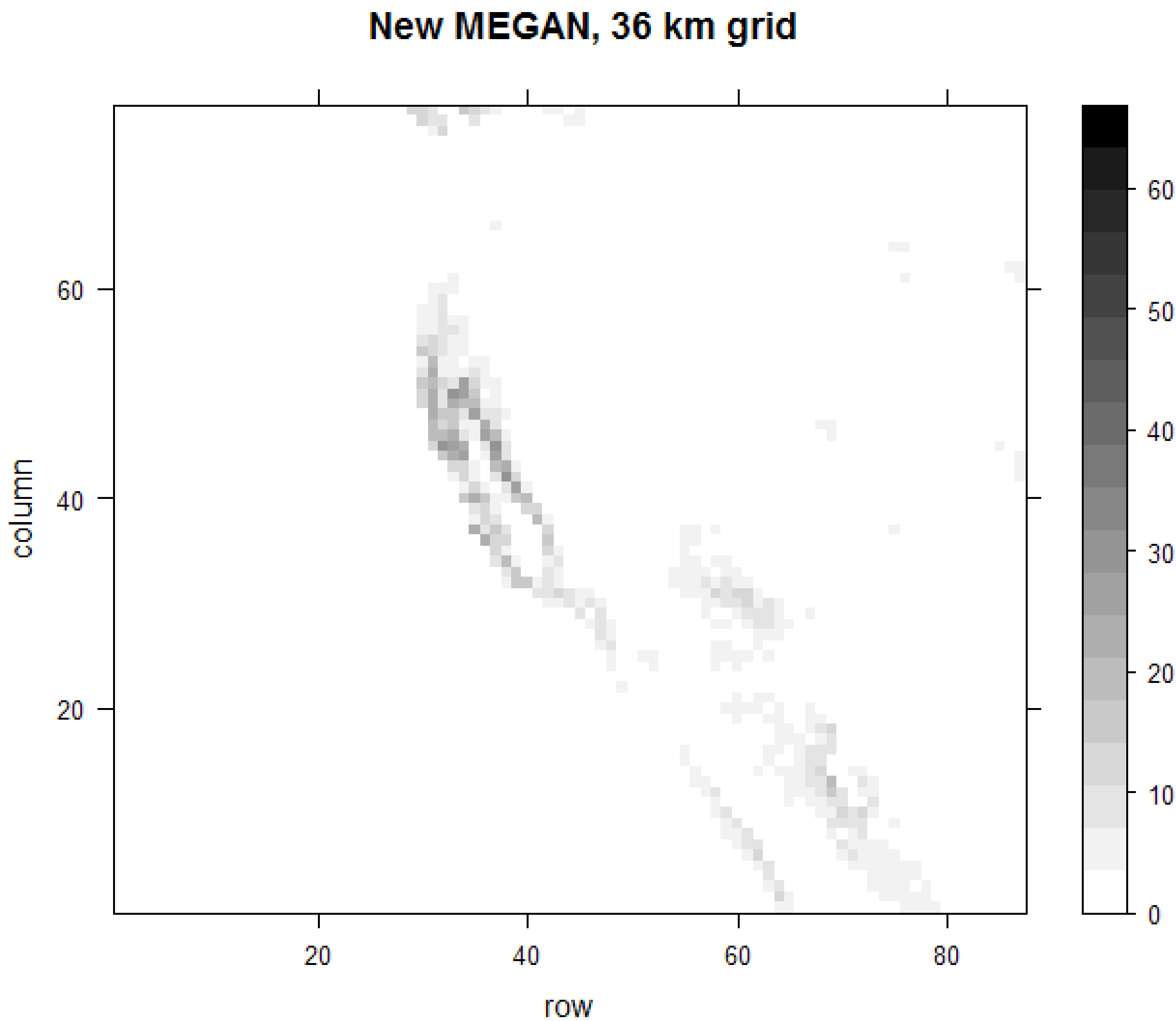

Figure 6 Isoprene emissions as predicted by the new MEGAN model for 4:00 p.m. PST on day 178 for the 36 km grid.

7. Quality assurance

All reasonable care has been taken to ensure that the current emission inventory is as accurate as possible. All measurements undertaken in this study were conducted in accordance with established techniques. The gas chromatograph was calibrated with a gas-phase standard purchased from Scott-Marrin Inc., Riverside, CA that contained high concentrations of isoprene and α-pinene. This standard was diluted with zero air using recently purchased mass flow controllers. In addition, and the system was also cross-calibrated at the National Center for Atmospheric Research with a wider range of monoterpenes. Finally, selected results from the Maricopa County measurements were compared to data independently collected by Dr. Brad Baker. Considering this, we believe our leaf-level measurements are accurate to within ± 10 %. As mentioned in above, this error estimate only considers the analytical precision and accuracy of our instrumentation, and is not related to the inherent variability of biogenic emission capacities.

Dr. Guenther's group at the National Center for Atmospheric Research leads the nation in conducting biogenic emission surveys within the United States (e.g., Guenther et al. 1994, e.g., Guenther et al. 1996b) and abroad (e.g., Guenther et al. 1996c, Guenther et al. 1999). Dr. Guenther assisted with the development of the original BEIS model, and is now leading the effort to create MEGAN. A complete discussion of error sources and impacts on the corresponding emission inventories is outside the scope of this report. Dr. Guenther has reported on the effectiveness of scaling emissions (Guenther et al. 1996a), and his inventories have been compared to satellite measurements (Palmer et al. 2003). In one previous study, uncertainty was estimated to be less than 50 % for maximum mid-day, summer isoprene emissions (Guenther et al. 2000) using modeling techniques similar to those employed in this study.

8. Checklist of deliverables

Task	Resolution
Development of work plan: Meet with the Project Oversight Committee (POC) to scope project and discuss methods to be used and issues related to this project. The POC will be the final decision authority over methods to be used for completing all elements of the project. Follow up meetings or conference calls will be conducted as necessary. **Milestone:** Meeting with Project Oversight Committee will be held within 5 days of contract award. Final work plan will be submitted within 10 days of contract award. **Deliverables:** Work plan.	Dr. Potosnak met with the POC on May 17, 2006.
Progress and status reports: Provide summary progress and status reports every two weeks during duration of contract. **Milestone:** Provide initial progress and status report within two weeks of approval of the final work plan, and then subsequent reports every two weeks thereafter until all contracted work is completed. **Deliverables:** Reports.	Dr. Potosnak sent email reports to Al Leskys every two weeks during the project.
Generate new BVOC emissions inventory: Based on available literature, revise plant specific emission factors for plant species that account for more than 85 percent of the emissions or land coverage in the current inventory—within the 1.3 and 4 km domains. Generate new emissions inventory based on BEIS3 framework and the revised emission factors. **Milestone:** Review BVOC emission factors of significant plant species, and generate emissions inventory. **Deliverables:** New emissions inventory based on BEIS3 framework.	Dr. Potosnak presented of the literature review at a meeting on July 6, 2006. The revised emission inventory is available, but DAQEM decided that it was not necessary to implement this inventory, since it did not address the 12 and 36 km grids.
Generate new BVOC emissions inventory: Compare land cover characterization scheme used in current inventory with data from Southwest Regional GAP (SWReGAP) database. If significant differences are observed generate a new emissions inventory based on BEIS3 framework and the SWReGAP land use classifications. **Milestone:** Compare land use categorizations and generate emissions inventory if appropriate. **Deliverables:** New emissions inventory based on BEIS3 framework.	Dr. Potosnak presented a comparison of the land cover characterizations for BEIS and SWReGAP at the July meeting. Comparisons are also provided in this final report.
Generate land cover characterization files: Based on current MM5/CMAQ grid domains for Clark County, generate MEGAN compatible land cover characterization files from the SWReGAP	Dr. Guenther completed this task, and has implemented this in

Task	Resolution
data. **Milestone:** Based on SWReGAP data, generate land cover characterization files. **Deliverables:** Land cover characterization files.	MEGAN.
Installation of MEGAN: Install a beta version of MEGAN that will produce CMAQ ready input files based on the MEGAN compatible classification files and MM5 meteorological files generated by the county. **Milestone:** Installation of the MEGAN model that will produce CMAQ ready input files. **Deliverables:** Beta version of MEGAN	Because the FORTRAN version of MEGAN is behind schedule, Dr. Guenther delivered a version written in Microsoft Acess.
Compare emission inventories: Compare generated BVOC emission inventories. **Milestone:** Include comparison in final report. **Deliverables:** Report.	The comparison of inventories is provided in this final report.
Presentation: Present analysis of newly generated emissions inventories. **Milestone:** Present results at a meeting held in Las Vegas. **Deliverables:** Presentation.	Drs. Potosnak and Guenther attended the Ozone Working Group meeting on August 16, 2006 and presented their results.
Measure plant emissions: Measure BVOC emissions from plants that account for more than 85 percent of the emissions or land coverage in the current inventory. Determine emission rates for relevant light, temperature and water availability regimes. **Milestone:** Include measurements in final report. **Deliverables:** Report.	Between May and August, 2006, Dr. Potosnak and Ms. Papiez measured all the required species in Clark County during four field campaigns. The results are included in the final report.
Deliver new land cover database: Deliver a new land cover database that integrates detailed Clark County land cover characteristic data into the MEGAN land cover database. **Milestone:** Demonstrate model to POC. **Deliverables:** Land cover database.	Dr. Guenther has integrated the land cover measurements with MEGAN.
Provide code and scripts: Provide MEGAN FORTRAN code and scripts that will generate CMAQ compatible input files directly from MM5 output files. **Milestone:** Demonstrate model to POC.	Although the FORTRAN code is still in development, Dr. Guenther has produced inventories based on MM5 output

Task	Resolution
Deliverables: Code and scripts.	provided by DAQEM.
Provide training: Install and train Clark County DAQEM personnel in the use of the new MEGAN framework. **Milestone:** Provide appropriate training to designated DAQEM personnel. **Deliverables:** Training.	This task was not accomplished in full, although Dr. Guenther provided training to Zheng Li on the Access version of MEGAN.
Submit final report: Provide the final report within two weeks of receiving comments from DAQEM concerning the draft final report. The final report will include a quality assured biogenic emissions inventory based on the new MEGAN framework, and an analysis of the reasonableness of the inventory. Such analysis may include, for example, comparative emission density maps, gridded graphs and summary tables. **Milestone:** Submit five (5) copies of final report. **Deliverables:** Final report.	This final report accomplishes all these objectives.
Presentation: Present the results of the entire project in a series of meetings. **Milestone:** Present results at meetings held in Las Vegas. **Deliverables:** Presentation.	As agreed to by the POC, the Drs. Guenther and Potosnak presented the results of this project at the Ozone Working Group meeting in August.

9. Daily emission summary tables

BVOC emissions (in tons/day) from Clark County:

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
5/19/03	4.4	21.7	0.0	0.1	3.5	15.2	2.7	0.5	8.2	38.2	14.7	3.1	46.4	86.3
5/20/03	5.1	25.2	0.0	0.1	4.1	18.0	3.1	0.6	9.5	47.2	17.6	3.3	56.7	103.5
5/21/03	6.0	30.0	0.0	0.1	4.9	21.4	3.7	0.7	11.3	56.5	20.7	3.8	67.8	123.3
5/22/03	6.5	32.5	0.0	0.2	5.5	22.3	4.0	0.7	12.4	56.9	21.2	4.1	69.3	128.6
5/23/03	6.7	33.1	0.0	0.2	5.7	22.3	4.0	0.7	12.7	55.6	21.0	4.3	68.3	128.3
5/24/03	6.6	33.0	0.0	0.2	5.7	22.0	4.0	0.7	12.7	54.4	20.6	4.3	67.0	126.5
5/25/03	6.3	31.2	0.0	0.2	5.2	21.7	3.8	0.7	11.8	56.2	20.8	4.0	68.0	125.2
5/26/03	6.0	29.6	0.0	0.1	5.0	20.4	3.6	0.6	11.3	51.7	19.4	3.9	63.0	117.0
5/27/03	8.1	40.4	0.0	0.2	6.9	28.5	4.9	0.9	15.2	75.8	27.3	4.7	91.0	165.7
5/28/03	9.6	48.4	0.0	0.2	8.6	32.7	5.8	1.0	18.5	83.2	30.2	5.6	101.7	189.5
5/29/03	9.2	46.3	0.0	0.2	8.3	30.7	5.6	0.9	17.8	76.2	28.2	5.6	93.9	177.4
5/30/03	8.0	40.0	0.0	0.2	6.9	27.1	4.8	0.8	15.3	68.9	25.4	4.9	84.2	156.8
5/31/03	7.4	37.0	0.0	0.2	6.4	25.4	4.5	0.8	14.1	64.8	23.9	4.6	78.9	146.5
6/1/03	7.3	36.4	0.0	0.2	6.2	25.5	4.5	0.8	13.8	67.2	24.3	4.7	81.0	148.1
6/2/03	8.1	40.4	0.0	0.2	7.0	28.5	4.9	0.9	15.3	75.6	27.0	5.1	90.8	165.5
6/3/03	8.2	40.7	0.0	0.2	7.1	28.5	5.0	0.9	15.4	75.0	26.9	5.1	90.5	165.5
6/4/03	7.8	38.6	0.0	0.2	6.7	27.1	4.7	0.8	14.6	71.5	25.7	4.9	86.1	157.3
6/5/03	7.1	35.3	0.0	0.2	6.0	24.8	4.3	0.8	13.3	65.5	23.7	4.6	78.8	144.0
6/6/03	7.0	34.5	0.0	0.2	5.8	24.6	4.2	0.8	13.0	65.6	23.6	4.5	78.6	142.6
6/7/03	7.6	37.9	0.0	0.2	6.5	26.8	4.6	0.8	14.3	71.5	25.6	4.8	85.8	156.0
6/8/03	7.7	38.6	0.0	0.2	6.6	27.2	4.7	0.8	14.6	72.2	25.9	4.9	86.8	158.1
6/9/03	6.5	32.2	0.0	0.2	5.6	21.8	3.9	0.7	12.4	54.8	20.4	4.5	67.1	125.6
6/10/03	5.4	26.4	0.0	0.1	4.4	18.5	3.2	0.6	10.0	47.8	17.8	3.8	57.8	106.4
6/11/03	5.3	25.8	0.0	0.1	4.2	18.3	3.2	0.6	9.7	48.0	17.7	3.7	57.7	105.5
6/12/03	5.2	25.5	0.0	0.1	4.2	18.3	3.2	0.6	9.6	48.4	17.8	3.6	58.0	105.5
6/13/03	5.4	26.4	0.0	0.1	4.3	19.1	3.3	0.6	9.9	51.1	18.7	3.6	61.0	110.3
6/14/03	6.3	31.2	0.0	0.1	5.2	22.7	3.8	0.7	11.7	61.7	22.1	4.1	73.3	131.8
6/15/03	7.0	34.7	0.0	0.2	5.8	25.1	4.3	0.8	13.0	68.1	24.3	4.4	81.1	146.0
6/20/03	4.8	23.7	0.0	0.1	3.9	16.7	2.9	0.5	9.0	42.7	16.1	3.5	51.7	95.4
6/21/03	4.6	22.7	0.0	0.1	3.7	16.2	2.8	0.5	8.5	42.2	15.7	3.3	50.7	92.8
6/22/03	4.8	23.3	0.0	0.1	3.8	16.5	2.9	0.5	8.8	42.6	16.0	3.4	51.4	94.4
6/23/03	4.7	23.1	0.0	0.1	3.8	16.4	2.9	0.5	8.7	42.2	15.9	3.4	51.0	93.8
6/24/03	3.7	18.0	0.0	0.1	3.0	12.3	2.2	0.4	6.9	29.5	11.7	2.9	36.4	69.1
6/25/03	4.5	22.0	0.0	0.1	3.5	16.0	2.7	0.5	8.2	42.5	15.7	3.2	50.7	91.8
6/26/03	5.8	28.7	0.0	0.1	4.7	20.6	3.5	0.6	10.8	54.5	19.9	3.9	65.3	118.7
6/27/03	7.1	35.4	0.0	0.2	6.0	25.3	4.3	0.8	13.3	67.7	24.3	4.5	81.0	146.8
6/28/03	8.5	42.5	0.0	0.2	7.4	29.8	5.2	0.9	16.1	78.7	28.1	5.2	94.8	173.2
6/29/03	9.1	45.9	0.0	0.2	8.2	31.3	5.5	1.0	17.5	80.6	29.0	5.7	98.1	181.9
6/30/03	7.8	39.1	0.0	0.2	6.9	26.8	4.8	0.8	14.9	68.1	24.9	5.1	83.0	154.5
7/1/03	7.8	38.8	0.0	0.2	6.6	28.5	4.8	0.9	14.3	78.5	27.6	4.9	92.9	166.1
7/2/03	7.9	39.3	0.0	0.2	6.7	28.7	4.9	0.9	14.5	78.7	27.7	5.0	93.3	167.2
7/3/03	8.1	40.3	0.0	0.2	6.9	29.6	5.0	0.9	15.0	81.8	28.6	5.0	96.8	172.8
7/4/03	9.0	44.9	0.0	0.2	7.8	32.8	5.5	1.0	16.7	90.2	31.4	5.5	106.9	191.5
7/5/03	9.8	49.2	0.0	0.2	8.6	35.7	6.0	1.1	18.3	98.2	34.0	5.9	116.5	208.9
7/6/03	9.3	46.7	0.0	0.2	8.2	33.8	5.7	1.1	17.4	92.5	32.2	5.7	109.9	197.6
7/7/03	8.5	42.4	0.0	0.2	7.3	30.9	5.2	1.0	15.8	84.7	29.6	5.3	100.5	180.2
7/8/03	8.7	43.6	0.0	0.2	7.5	31.9	5.4	1.0	16.2	88.2	30.7	5.3	104.4	186.6
7/9/03	10.0	50.3	0.0	0.2	8.8	36.7	6.2	1.2	18.7	101.4	35.0	5.9	120.1	214.9

BVOC emissions (in tons/day) from Clark County (cont'd):

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
7/10/03	11.9	59.8	0.0	0.3	10.9	42.9	7.3	1.3	22.4	116.2	40.0	6.8	138.6	250.6
7/11/03	11.4	57.3	0.0	0.3	10.6	39.7	7.0	1.2	21.7	104.2	36.5	6.9	125.9	231.6
7/12/03	11.4	57.2	0.0	0.3	10.4	40.5	7.0	1.3	21.6	108.7	37.7	6.7	130.2	236.6
7/13/03	11.6	58.3	0.0	0.3	10.8	40.3	7.1	1.2	22.1	105.4	36.9	7.0	127.5	235.0
7/14/03	11.6	58.7	0.0	0.3	10.8	40.9	7.1	1.3	22.2	107.5	37.6	7.0	129.7	238.3
7/15/03	11.2	56.5	0.0	0.3	10.5	38.8	6.9	1.2	21.4	100.6	35.4	6.9	122.0	225.9
7/16/03	8.4	41.7	0.0	0.2	8.1	24.7	5.0	0.7	16.6	51.1	20.6	6.2	67.7	139.9
7/17/03	8.0	39.9	0.0	0.2	7.3	26.4	4.9	0.8	15.4	64.4	23.9	5.5	79.8	151.8
7/18/03	8.8	43.8	0.0	0.2	7.8	29.9	5.4	0.9	16.7	77.0	27.7	5.7	93.7	173.8
7/19/03	6.7	33.2	0.0	0.2	5.7	23.4	4.1	0.7	12.6	61.8	22.4	4.5	74.4	135.8
7/20/03	8.7	43.3	0.0	0.2	7.5	30.9	5.3	1.0	16.2	83.0	29.3	5.5	99.2	179.9
7/21/03	10.4	51.9	0.0	0.2	9.2	37.0	6.3	1.2	19.5	100.0	34.8	6.3	119.5	216.3
7/22/03	9.1	45.4	0.0	0.2	8.4	29.8	5.5	0.9	17.6	72.1	26.7	6.1	89.7	171.5
7/23/03	8.3	41.7	0.0	0.2	7.5	27.9	5.1	0.8	16.0	69.2	25.5	5.7	85.2	160.8
7/24/03	6.1	30.0	0.0	0.2	5.3	19.7	3.7	0.6	11.6	47.3	18.1	4.5	58.9	112.8
7/25/03	4.0	19.0	0.0	0.1	3.5	10.2	2.3	0.3	7.9	15.8	8.2	3.7	23.7	55.2

Average summer day emissions ** :

	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
	7.8	**39.0**	**0.0**	**0.2**	**6.8**	**27.5**	**4.8**	**0.9**	**14.7**	**72.5**	**25.9**	**5.0**	**87.2**	**159.5**

* BVOC = OLE+PAR+TOL+XYL+ALD2+NR+ETH+FORM+ISOP (based on methodology used by EPA to create default 2002 BVOC EI)

** Average summer day emissions are based on data from (June 1, 2003 to June 15, 2003), and (June 20, 2003 to July 23, 2003).

BVOC emissions (in tons/day) from 1.3 km domain:

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
5/19/03	3.5	17.0	0.0	0.1	2.8	11.5	2.1	0.3	6.5	28.8	11.0	2.3	35.3	66.1
5/20/03	4.0	19.6	0.0	0.1	3.2	13.6	2.4	0.4	7.4	35.4	13.1	2.5	42.9	78.7
5/21/03	4.7	23.4	0.0	0.1	3.9	16.2	2.8	0.5	8.9	42.5	15.5	2.9	51.4	94.1
5/22/03	5.2	25.7	0.0	0.1	4.4	17.2	3.1	0.5	9.9	43.7	16.1	3.2	53.5	99.9
5/23/03	5.2	25.7	0.0	0.1	4.5	16.7	3.1	0.5	10.0	40.7	15.4	3.3	50.7	96.4
5/24/03	5.1	25.4	0.0	0.1	4.4	16.6	3.1	0.5	9.8	40.5	15.3	3.3	50.3	95.7
5/25/03	4.9	24.3	0.0	0.1	4.1	16.5	3.0	0.5	9.3	42.2	15.5	3.1	51.5	95.6
5/26/03	4.7	23.1	0.0	0.1	3.9	15.5	2.8	0.5	8.9	39.2	14.6	3.0	48.1	89.9
5/27/03	6.3	31.5	0.0	0.2	5.4	21.6	3.8	0.7	12.0	57.5	20.4	3.6	69.4	127.0
5/28/03	7.6	38.1	0.0	0.2	6.9	25.0	4.6	0.8	14.7	63.4	22.8	4.3	78.1	146.5
5/29/03	7.2	36.1	0.0	0.2	6.5	23.1	4.3	0.7	14.0	56.4	20.8	4.3	70.4	134.5
5/30/03	6.3	31.3	0.0	0.2	5.5	20.6	3.8	0.6	12.0	51.9	19.0	3.8	64.0	120.2
5/31/03	5.8	29.1	0.0	0.1	5.0	19.3	3.5	0.6	11.2	49.0	18.0	3.6	60.2	112.5
6/1/03	5.7	28.5	0.0	0.1	4.9	19.5	3.5	0.6	10.9	51.2	18.4	3.6	62.1	114.2
6/2/03	6.4	31.9	0.0	0.2	5.5	21.9	3.9	0.7	12.1	58.0	20.5	3.9	70.1	128.4
6/3/03	6.5	32.3	0.0	0.2	5.7	22.0	3.9	0.7	12.3	57.5	20.5	4.0	69.8	128.7
6/4/03	6.2	30.7	0.0	0.2	5.3	20.9	3.7	0.6	11.7	54.8	19.5	3.8	66.5	122.4
6/5/03	5.7	28.0	0.0	0.1	4.8	19.2	3.4	0.6	10.7	50.4	18.1	3.6	61.1	112.3
6/6/03	5.6	27.5	0.0	0.1	4.7	19.1	3.4	0.6	10.5	50.7	18.1	3.5	61.2	111.7
6/7/03	6.0	29.9	0.0	0.1	5.2	20.5	3.6	0.6	11.4	54.3	19.3	3.7	65.6	120.3
6/8/03	6.1	30.2	0.0	0.2	5.2	20.7	3.7	0.6	11.5	54.6	19.4	3.8	66.2	121.3
6/9/03	5.0	24.9	0.0	0.1	4.3	16.3	3.0	0.5	9.6	40.3	15.1	3.4	50.0	94.6
6/10/03	4.2	20.6	0.0	0.1	3.4	14.1	2.5	0.4	7.9	36.1	13.4	2.9	44.0	81.5

BVOC emissions (in tons/day) from 1.3 km domain (cont'd):

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
6/11/03	4.1	20.0	0.0	0.1	3.3	13.9	2.5	0.4	7.6	36.0	13.3	2.8	43.6	80.3
6/12/03	4.0	19.6	0.0	0.1	3.2	13.7	2.4	0.4	7.4	36.0	13.2	2.7	43.4	79.5
6/13/03	4.2	20.4	0.0	0.1	3.3	14.5	2.5	0.4	7.7	38.7	14.0	2.8	46.4	84.2
6/14/03	4.9	24.4	0.0	0.1	4.1	17.3	3.0	0.5	9.2	47.1	16.7	3.1	56.3	101.5
6/15/03	5.5	27.1	0.0	0.1	4.6	19.2	3.3	0.6	10.2	52.0	18.4	3.4	62.3	112.5
6/20/03	3.7	18.2	0.0	0.1	3.0	12.4	2.2	0.4	6.9	31.6	11.8	2.6	38.5	71.7
6/21/03	3.6	17.4	0.0	0.1	2.8	12.1	2.1	0.4	6.6	31.4	11.7	2.5	38.0	70.0
6/22/03	3.7	18.0	0.0	0.1	2.9	12.5	2.2	0.4	6.8	32.1	11.9	2.6	39.0	71.9
6/23/03	3.7	17.9	0.0	0.1	2.9	12.3	2.2	0.4	6.8	31.5	11.8	2.6	38.3	71.0
6/24/03	2.8	13.7	0.0	0.1	2.3	9.1	1.7	0.3	5.3	21.3	8.5	2.2	26.6	51.3
6/25/03	3.5	17.1	0.0	0.1	2.8	12.2	2.1	0.4	6.5	32.1	11.8	2.4	38.6	70.2
6/26/03	4.6	22.5	0.0	0.1	3.7	15.7	2.8	0.5	8.5	41.6	15.1	3.0	50.1	91.5
6/27/03	5.6	27.8	0.0	0.1	4.7	19.4	3.4	0.6	10.5	51.7	18.4	3.5	62.3	113.4
6/28/03	6.7	33.5	0.0	0.2	5.9	22.9	4.0	0.7	12.8	60.3	21.3	4.0	73.0	134.2
6/29/03	7.2	35.9	0.0	0.2	6.5	23.9	4.3	0.7	13.8	61.3	21.9	4.3	75.1	139.9
6/30/03	6.0	29.9	0.0	0.2	5.3	19.9	3.6	0.6	11.5	50.5	18.4	3.8	62.0	116.0
7/1/03	5.9	29.5	0.0	0.1	5.0	21.2	3.6	0.7	11.0	58.4	20.2	3.7	69.4	124.4
7/2/03	6.0	29.7	0.0	0.1	5.1	21.2	3.7	0.7	11.1	58.0	20.2	3.8	69.1	124.3
7/3/03	6.2	30.8	0.0	0.1	5.3	22.1	3.8	0.7	11.5	61.2	21.1	3.8	72.7	130.1
7/4/03	6.9	34.3	0.0	0.2	6.0	24.4	4.2	0.8	12.9	67.5	23.2	4.2	80.4	144.3
7/5/03	7.6	37.8	0.0	0.2	6.7	26.8	4.6	0.8	14.2	74.0	25.3	4.5	88.1	158.4
7/6/03	7.2	35.8	0.0	0.2	6.3	25.3	4.4	0.8	13.4	69.1	23.8	4.3	82.5	148.9
7/7/03	6.5	32.4	0.0	0.2	5.6	23.1	4.0	0.7	12.1	63.6	21.9	4.0	75.7	136.0
7/8/03	6.8	33.6	0.0	0.2	5.8	24.0	4.1	0.8	12.6	66.7	22.9	4.1	79.3	141.9
7/9/03	7.8	38.7	0.0	0.2	6.8	27.6	4.7	0.9	14.5	76.5	26.0	4.5	91.0	163.2
7/10/03	9.1	45.8	0.0	0.2	8.4	32.1	5.5	1.0	17.2	87.4	29.6	5.2	104.7	189.6
7/11/03	8.9	44.5	0.0	0.2	8.3	30.2	5.4	0.9	17.0	79.0	27.3	5.3	96.0	177.3
7/12/03	8.9	44.8	0.0	0.2	8.2	30.9	5.4	1.0	17.0	83.0	28.4	5.2	100.0	182.5
7/13/03	9.0	45.3	0.0	0.2	8.5	30.5	5.5	0.9	17.3	79.5	27.5	5.4	96.8	179.4
7/14/03	8.9	44.7	0.0	0.2	8.3	30.3	5.4	0.9	17.0	79.1	27.4	5.3	96.1	177.8
7/15/03	8.7	43.7	0.0	0.2	8.1	29.5	5.3	0.9	16.7	76.6	26.6	5.3	93.3	173.1
7/16/03	6.3	31.3	0.0	0.2	6.1	17.9	3.8	0.5	12.6	35.5	14.5	4.7	48.1	101.5
7/17/03	6.0	29.9	0.0	0.2	5.5	19.2	3.6	0.6	11.6	46.0	17.1	4.2	57.6	111.0
7/18/03	6.8	33.7	0.0	0.2	6.1	22.5	4.1	0.7	13.0	57.6	20.6	4.4	70.6	131.6
7/19/03	4.9	24.2	0.0	0.1	4.1	16.7	3.0	0.5	9.2	43.8	15.8	3.3	53.0	97.4
7/20/03	6.5	32.4	0.0	0.2	5.7	22.6	4.0	0.7	12.2	61.0	21.3	4.1	73.2	133.0
7/21/03	7.9	39.7	0.0	0.2	7.1	27.6	4.8	0.9	15.0	74.6	25.7	4.8	89.6	162.7
7/22/03	7.0	34.8	0.0	0.2	6.5	22.1	4.2	0.7	13.6	52.6	19.5	4.7	66.2	128.1
7/23/03	6.3	31.2	0.0	0.2	5.7	20.2	3.8	0.6	12.1	49.4	18.2	4.3	61.5	117.4
7/24/03	4.4	21.4	0.0	0.1	3.8	13.7	2.6	0.4	8.4	32.1	12.4	3.3	40.5	78.5
7/25/03	2.9	13.8	0.0	0.1	2.6	7.1	1.7	0.2	5.8	10.0	5.6	2.7	15.8	38.3

Average summer day emissions ** :

	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
	6.1	**30.1**	**0.0**	**0.1**	**5.3**	**20.7**	**3.7**	**0.6**	**11.5**	**54.4**	**19.3**	**3.8**	**65.8**	**121.0**

* BVOC = OLE+PAR+TOL+XYL+ALD2+NR+ETH+FORM+ISOP (based on methodology used by EPA to create default 2002 BVOC EI)

** Average summer day emissions are based on data from (June 1, 2003 to June 15, 2003), and (June 20, 2003 to July 23, 2003).

BVOC emissions (in tons/day) from 4 km domain:

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
5/19/03	23.1	112.0	0.1	0.6	18.1	79.1	13.9	2.4	42.2	211.2	76.3	14.7	253.4	460.4
5/20/03	27.3	133.6	0.1	0.7	21.7	96.1	16.6	3.0	49.9	267.3	93.4	16.3	317.2	566.3
5/21/03	32.5	159.8	0.1	0.8	26.3	114.6	19.7	3.6	59.7	321.2	110.7	18.5	380.9	678.6
5/22/03	35.1	173.3	0.1	0.9	29.4	120.3	21.3	3.7	65.4	321.2	113.9	20.4	386.6	705.2
5/23/03	35.4	173.9	0.1	0.9	29.7	118.1	21.3	3.6	66.4	310.7	110.8	20.8	377.1	693.7
5/24/03	34.9	171.6	0.1	0.9	29.4	115.3	21.1	3.5	65.9	298.7	107.8	20.9	364.6	675.5
5/25/03	31.9	156.0	0.1	0.8	26.0	108.6	19.2	3.3	59.3	292.9	103.7	18.8	352.2	638.8
5/26/03	30.6	149.2	0.1	0.8	24.8	103.7	18.4	3.2	56.7	279.6	99.0	18.1	336.3	610.1
5/27/03	42.1	208.7	0.1	1.0	35.4	148.2	25.5	4.6	78.3	419.4	141.5	22.5	497.7	885.1
5/28/03	50.2	250.3	0.1	1.2	44.6	169.8	30.4	5.2	95.4	454.0	156.6	27.0	549.4	1005.9
5/29/03	47.3	235.3	0.1	1.2	41.9	156.8	28.7	4.7	90.2	407.6	143.6	26.7	497.8	923.7
5/30/03	40.5	200.1	0.1	1.0	34.6	136.0	24.5	4.1	76.3	360.0	127.1	23.3	436.3	800.9
5/31/03	38.1	188.2	0.1	0.9	32.1	129.6	23.1	4.0	71.4	348.1	122.4	22.0	419.6	764.2
6/1/03	37.1	181.8	0.1	0.9	31.0	129.1	22.6	4.0	68.7	360.5	122.8	22.5	429.1	767.0
6/2/03	41.0	201.4	0.1	1.0	34.7	143.4	25.0	4.5	76.0	403.3	136.0	24.2	479.3	854.2
6/3/03	41.0	201.4	0.1	1.0	34.9	142.3	24.9	4.4	76.1	396.9	134.5	24.4	473.0	846.9
6/4/03	38.7	189.7	0.1	0.9	32.6	134.2	23.5	4.2	71.8	372.6	127.2	23.3	444.3	796.4
6/5/03	35.6	174.2	0.1	0.9	29.7	123.7	21.7	3.8	65.7	342.3	117.6	22.0	408.0	731.9
6/6/03	35.2	172.3	0.1	0.9	29.1	123.5	21.4	3.8	64.9	347.2	118.3	21.4	412.1	733.6
6/7/03	37.9	185.8	0.1	0.9	31.7	133.0	23.1	4.1	70.0	375.1	126.9	22.6	445.1	791.7
6/8/03	39.5	194.3	0.1	1.0	33.4	138.4	24.1	4.3	73.3	389.4	131.5	23.5	462.7	824.5
6/9/03	33.1	161.2	0.1	0.8	27.8	110.8	20.0	3.4	61.8	292.8	103.8	21.3	354.6	650.1
6/10/03	27.1	130.9	0.1	0.7	21.8	92.4	16.4	2.8	49.9	249.4	88.5	17.9	299.3	541.5
6/11/03	25.7	124.0	0.1	0.6	20.4	88.7	15.5	2.7	47.0	242.6	85.6	16.9	289.6	520.4
6/12/03	25.5	122.6	0.1	0.6	20.1	88.3	15.3	2.7	46.4	245.3	85.6	16.5	291.7	520.5
6/13/03	26.8	129.5	0.1	0.6	21.1	94.7	16.2	2.9	48.6	268.3	92.2	16.9	316.9	560.2
6/14/03	32.2	156.9	0.1	0.8	25.9	115.2	19.6	3.6	58.6	333.0	112.1	19.4	391.7	687.3
6/15/03	35.2	172.1	0.1	0.8	28.9	125.1	21.4	3.9	64.5	359.0	120.6	20.9	423.5	746.6
6/20/03	23.8	114.2	0.1	0.6	18.9	80.4	14.3	2.4	43.6	214.7	77.1	16.0	258.3	469.3
6/21/03	22.7	109.2	0.1	0.6	17.8	78.3	13.7	2.4	41.4	213.1	75.8	15.2	254.5	457.8
6/22/03	23.5	113.1	0.1	0.6	18.5	80.9	14.2	2.5	42.9	220.4	78.2	15.6	263.3	473.7
6/23/03	23.0	110.9	0.1	0.6	18.2	79.0	13.9	2.4	42.1	212.8	76.2	15.6	254.9	460.9
6/24/03	19.0	91.0	0.1	0.5	14.9	63.6	11.4	1.9	34.7	162.9	60.7	13.9	197.6	365.3
6/25/03	23.9	115.6	0.1	0.6	18.7	85.0	14.5	2.6	43.1	238.7	83.1	15.7	281.8	499.7
6/26/03	30.5	149.0	0.1	0.7	24.8	108.1	18.6	3.4	55.7	306.4	104.3	19.0	362.2	641.6
6/27/03	37.0	181.9	0.1	0.9	31.0	130.9	22.6	4.1	68.1	374.1	125.2	22.0	442.2	782.5
6/28/03	43.9	216.5	0.1	1.1	38.0	153.2	26.7	4.8	81.6	432.6	144.0	25.3	514.2	916.8
6/29/03	46.2	227.8	0.1	1.1	40.7	157.5	28.0	4.8	86.8	435.0	145.9	26.8	521.8	941.2
6/30/03	39.6	194.4	0.1	1.0	34.1	134.4	24.0	4.1	74.0	366.9	125.4	23.9	440.9	798.6
7/1/03	39.2	192.5	0.1	0.9	32.7	141.7	24.1	4.5	71.5	412.3	136.5	23.3	483.7	847.8
7/2/03	39.2	192.5	0.1	0.9	32.7	141.2	24.1	4.5	71.7	410.7	135.9	23.4	482.5	846.0
7/3/03	40.5	198.7	0.1	1.0	33.7	146.5	24.8	4.6	74.0	432.1	141.3	23.6	506.1	881.9
7/4/03	45.8	225.3	0.1	1.1	38.9	165.5	28.0	5.2	84.0	488.8	158.5	25.9	572.7	998.6
7/5/03	49.4	243.7	0.1	1.2	42.6	178.1	30.2	5.6	91.0	524.5	169.5	27.6	615.5	1075.4
7/6/03	45.6	224.4	0.1	1.1	39.0	163.1	27.9	5.1	84.1	475.1	155.3	26.2	559.2	981.4
7/7/03	41.9	205.6	0.1	1.0	35.2	150.2	25.6	4.7	77.0	437.6	144.0	24.4	514.6	901.9
7/8/03	43.3	212.7	0.1	1.0	36.4	156.4	26.5	4.9	79.4	459.8	150.3	24.9	539.3	941.1
7/9/03	50.6	249.4	0.1	1.2	43.5	183.4	30.9	5.8	93.1	546.0	175.1	27.8	639.0	1110.9
7/10/03	59.8	296.7	0.1	1.4	53.9	213.7	36.5	6.7	111.3	625.0	199.4	32.1	736.3	1293.9
7/11/03	57.0	282.0	0.1	1.4	51.4	198.5	34.7	6.2	106.9	560.8	183.5	32.0	667.7	1192.1

BVOC emissions (in tons/day) from 4 km domain (cont'd):

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
7/12/03	56.5	280.1	0.1	1.4	50.7	199.3	34.5	6.2	105.7	568.4	185.5	31.7	674.1	1197.2
7/13/03	57.1	283.4	0.1	1.4	52.0	197.7	34.9	6.1	107.5	550.9	181.5	32.5	658.4	1183.5
7/14/03	57.4	284.7	0.1	1.4	52.2	199.7	35.0	6.2	107.7	561.7	183.8	32.2	669.5	1198.4
7/15/03	55.1	273.6	0.1	1.4	50.6	188.1	33.6	5.8	104.2	506.2	171.1	32.1	610.4	1114.4
7/16/03	41.9	204.5	0.1	1.1	39.4	122.1	25.0	3.4	82.1	273.1	102.3	28.9	355.2	710.7
7/17/03	37.9	183.6	0.1	0.9	33.2	121.4	22.6	3.6	72.1	313.9	110.3	24.3	386.0	717.3
7/18/03	43.9	214.3	0.1	1.1	38.3	146.5	26.5	4.5	82.8	393.2	135.4	27.1	476.0	868.3
7/19/03	34.6	167.2	0.1	0.8	29.0	115.5	20.8	3.5	64.6	314.6	108.3	21.9	379.3	686.1
7/20/03	43.4	212.8	0.1	1.0	36.9	153.2	26.5	4.8	80.2	444.1	145.7	25.3	524.3	922.7
7/21/03	52.3	257.8	0.1	1.2	45.8	184.5	31.9	5.8	97.3	531.9	173.5	29.4	629.2	1111.3
7/22/03	48.0	236.0	0.1	1.2	43.4	158.1	29.1	4.8	91.3	413.1	143.0	29.6	504.4	933.7
7/23/03	42.4	208.4	0.1	1.1	37.9	137.9	25.8	4.1	80.6	350.0	124.5	27.7	430.5	807.6
7/24/03	32.5	157.0	0.1	0.8	27.8	103.2	19.5	3.1	61.4	254.9	94.1	22.3	316.3	598.8
7/25/03	21.0	98.7	0.1	0.6	18.2	54.9	12.3	1.4	40.8	95.5	45.3	17.9	136.3	302.6

Average summer day emissions ** :

	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
	39.3	**192.9**	**0.1**	**1.0**	**33.6**	**136.7**	**23.9**	**4.2**	**73.0**	**382.6**	**128.8**	**23.6**	**455.6**	**814.3**

* BVOC = OLE+PAR+TOL+XYL+ALD2+NR+ETH+FORM+ISOP (based on methodology used by EPA to create default 2002 BVOC EI)

** Average summer day emissions are based on data from (June 1, 2003 to June 15, 2003), and (June 20, 2003 to July 23, 2003).

BVOC emissions (in tons/day) from 12 km domain:

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
5/19/03	716.5	3272.5	1.8	13.0	538.2	1809.1	323.6	52.3	1415.0	4985.5	1643.7	159.8	6400.5	11712.4
5/20/03	862.8	3973.7	2.0	15.8	660.0	2182.1	394.4	63.8	1708.8	5977.0	1974.5	186.1	7685.8	14131.6
5/21/03	990.7	4582.7	2.2	18.1	764.9	2506.0	454.5	74.1	1962.7	6892.3	2263.9	210.4	8855.0	16285.6
5/22/03	1090.7	5068.1	2.4	20.1	851.4	2715.5	499.1	80.3	2175.9	7210.9	2432.8	229.5	9386.8	17538.5
5/23/03	1198.1	5596.2	2.6	22.1	941.1	2968.9	546.7	88.5	2402.5	7603.8	2657.1	246.7	10006.3	18968.1
5/24/03	1063.2	5015.0	2.5	20.7	846.5	2630.9	495.5	76.1	2174.4	6164.8	2337.8	244.6	8339.1	16315.2
5/25/03	829.3	3908.0	2.2	16.8	654.0	2101.7	396.0	59.0	1698.9	4882.7	1880.2	217.4	6581.6	12849.7
5/26/03	854.8	3997.3	2.1	16.8	660.5	2193.0	403.4	63.1	1718.0	5547.0	1988.3	214.8	7265.0	13737.9
5/27/03	1226.6	5717.6	2.6	22.3	952.1	3095.3	558.4	93.6	2432.3	8492.5	2804.8	252.8	10924.8	20161.1
5/28/03	1456.3	6872.6	3.0	27.4	1179.4	3616.7	673.7	108.0	2942.9	9316.4	3193.7	299.5	12259.3	23253.4
5/29/03	1364.4	6475.6	2.9	26.6	1119.3	3334.7	636.4	97.5	2806.6	7918.9	2910.0	297.8	10725.4	20976.4
5/30/03	1045.3	4947.6	2.5	21.0	843.5	2580.7	494.0	73.5	2157.2	6153.6	2272.6	258.9	8310.8	16161.6
5/31/03	1017.8	4739.6	2.4	19.4	790.3	2577.0	474.7	75.6	2032.7	6722.4	2326.4	238.4	8755.1	16419.1
6/1/03	1192.5	5491.7	2.7	21.9	926.2	2930.6	538.3	86.2	2387.3	7703.9	2624.3	240.4	10091.3	18894.0
6/2/03	1300.4	5985.4	2.8	23.5	1016.9	3190.2	584.0	94.7	2596.5	8571.1	2847.1	250.7	11167.6	20769.0
6/3/03	1391.3	6402.5	2.9	24.7	1094.0	3329.2	610.6	99.4	2808.1	8769.1	2951.2	249.1	11577.2	21723.6
6/4/03	1382.1	6404.0	2.9	24.3	1102.5	3233.6	596.8	96.1	2862.0	8268.0	2842.4	238.0	11130.0	21110.3
6/5/03	1416.7	6616.5	2.9	24.7	1151.1	3243.4	602.0	96.1	3008.9	7872.9	2822.1	228.1	10881.8	21026.4
6/6/03	1412.5	6611.3	2.9	24.8	1145.1	3255.1	603.2	96.6	3002.1	7774.9	2847.0	229.8	10777.0	20926.4
6/7/03	1351.7	6295.7	2.9	24.0	1080.1	3176.6	587.2	94.1	2823.6	7785.8	2804.2	236.4	10609.4	20398.2
6/8/03	1325.6	6158.9	2.9	24.0	1047.2	3174.8	585.8	93.9	2725.3	7927.1	2823.8	248.9	10652.4	20340.3
6/9/03	1175.1	5439.7	2.7	22.0	923.4	2764.1	520.0	79.8	2429.5	6480.1	2441.8	236.0	8909.6	17406.9
6/10/03	1042.4	4822.8	2.5	19.5	804.8	2490.9	461.3	71.8	2148.7	5752.4	2232.4	212.3	7901.1	15468.6
6/11/03	981.6	4539.1	2.4	18.4	753.4	2356.8	433.8	67.8	2021.3	5452.2	2120.3	202.5	7473.5	14605.3

BVOC emissions (in tons/day) from 12 km domain (cont'd):

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
6/12/03	966.6	4474.2	2.4	18.2	742.8	2324.3	428.8	66.6	1990.5	5336.6	2089.1	202.2	7327.1	14360.4
6/13/03	946.5	4372.3	2.4	18.1	727.6	2314.4	428.1	65.7	1933.2	5585.3	2081.4	206.7	7518.6	14460.5
6/14/03	1102.1	5080.6	2.5	20.2	836.9	2758.7	496.5	81.8	2192.7	7215.7	2515.8	225.3	9408.4	17595.0
6/15/03	1298.1	6009.9	2.8	23.6	1000.9	3222.2	582.5	96.7	2584.2	8555.4	2916.4	252.2	11139.6	20792.2
6/20/03	877.2	4051.0	2.3	17.0	676.0	2125.7	396.6	59.5	1797.2	5067.7	1897.7	197.7	6864.9	13273.0
6/21/03	804.2	3673.9	2.1	15.2	610.1	1978.6	361.7	55.6	1627.7	4936.0	1782.3	179.4	6563.7	12437.4
6/22/03	823.3	3754.2	2.1	15.3	621.5	2036.8	369.5	57.9	1651.7	5239.3	1841.2	179.7	6891.0	12919.9
6/23/03	803.3	3657.8	2.1	15.0	607.8	1976.5	360.7	55.6	1612.7	5031.5	1778.6	177.1	6644.1	12510.3
6/24/03	877.0	3960.7	2.1	15.6	657.8	2100.9	380.1	60.5	1753.1	5528.9	1889.1	170.8	7282.0	13583.8
6/25/03	1214.6	5527.6	2.6	20.8	933.9	2871.7	517.9	85.9	2448.7	7949.9	2565.5	197.8	10398.6	19124.8
6/26/03	1570.7	7237.7	3.0	26.9	1250.9	3677.8	669.1	111.2	3209.8	10057.3	3233.0	238.1	13267.1	24604.6
6/27/03	1768.7	8213.8	3.3	30.7	1442.5	4117.7	759.5	124.0	3650.0	10958.9	3570.1	272.8	14608.9	27419.1
6/28/03	1852.3	8667.8	3.5	32.5	1530.7	4333.4	801.3	130.5	3854.5	11285.2	3746.3	292.3	15139.7	28637.3
6/29/03	1733.6	8170.7	3.4	31.5	1426.5	4131.8	769.2	123.6	3610.6	10380.1	3603.9	301.6	13990.8	26770.6
6/30/03	1478.8	6908.0	3.1	27.7	1174.7	3593.5	667.6	106.6	2996.5	9231.8	3188.6	288.4	12228.3	23191.7
7/1/03	1368.6	5982.5	2.9	23.5	1028.4	3516.9	632.2	106.7	2533.9	9935.9	3199.1	281.9	12469.8	22597.6
7/2/03	1341.7	5850.6	2.8	22.9	1004.0	3452.4	617.9	105.1	2477.1	9904.2	3146.2	274.0	12381.3	22301.6
7/3/03	1415.9	6165.5	2.9	23.6	1052.8	3688.7	650.8	113.8	2584.6	10951.9	3385.8	280.1	13536.4	24065.8
7/4/03	1518.5	6605.6	3.0	25.0	1132.6	3954.6	694.4	122.8	2757.2	12060.8	3624.3	291.4	14818.0	26117.3
7/5/03	1586.0	6906.6	3.1	26.1	1190.7	4131.2	727.1	128.3	2882.1	12495.3	3776.0	302.9	15377.4	27194.4
7/6/03	1512.1	6592.1	3.0	25.3	1137.5	3901.8	693.6	120.1	2778.1	11429.3	3556.5	296.4	14207.4	25414.8
7/7/03	1446.8	6305.6	3.0	24.2	1082.5	3719.6	662.3	114.2	2668.5	10644.0	3398.3	285.5	13312.5	24002.2
7/8/03	1404.4	6128.2	2.9	23.6	1050.7	3658.4	648.3	112.4	2579.6	10919.6	3349.9	281.9	13499.3	23948.5
7/9/03	1684.0	7319.8	3.2	27.1	1264.0	4358.9	762.5	136.6	3061.9	13218.0	3985.6	304.4	16280.0	28774.0
7/10/03	1924.7	8388.5	3.5	31.3	1472.0	4909.3	869.6	153.4	3520.5	14604.8	4431.4	340.5	18125.4	32357.1
7/11/03	1904.8	8295.8	3.5	31.6	1462.2	4788.2	863.1	148.0	3502.8	13880.8	4288.3	347.6	17383.5	31378.0
7/12/03	1882.4	8220.5	3.5	31.6	1447.8	4786.9	862.1	147.9	3457.1	13799.0	4296.9	352.4	17256.1	31181.7
7/13/03	1716.5	7547.5	3.4	29.5	1332.4	4421.2	800.5	135.0	3171.0	12777.2	3961.0	346.5	15948.2	28763.2
7/14/03	1796.7	7806.6	3.4	29.8	1374.2	4567.0	818.4	141.0	3266.9	13492.8	4098.6	344.8	16759.7	30030.0
7/15/03	1857.8	8058.2	3.5	31.3	1433.7	4624.8	846.9	141.1	3401.2	12979.5	4099.8	356.9	16380.7	29977.0
7/16/03	1758.2	7603.8	3.4	29.7	1347.5	4306.3	795.6	130.6	3225.0	11901.3	3806.3	335.4	15126.3	27876.4
7/17/03	1910.1	8213.4	3.6	31.4	1466.8	4523.3	839.3	137.7	3519.9	12351.4	3953.8	330.5	15871.3	29476.9
7/18/03	2005.9	8623.1	3.7	32.7	1553.0	4714.2	875.9	143.5	3720.2	12553.5	4099.9	330.8	16273.6	30505.5
7/19/03	1973.6	8586.5	3.7	32.8	1557.6	4671.2	874.3	141.4	3736.1	12123.0	4044.6	330.3	15859.1	29964.0
7/20/03	2010.9	8743.1	3.7	33.0	1578.5	4783.8	884.5	145.9	3794.9	12935.0	4168.3	337.1	16729.9	31118.3
7/21/03	2135.9	9287.4	3.8	34.6	1691.0	5005.9	927.8	152.8	4062.6	13386.5	4328.5	341.6	17449.2	32625.8
7/22/03	2189.3	9467.3	3.9	35.5	1718.9	5125.8	950.6	156.6	4109.3	13682.2	4437.6	351.2	17791.5	33330.1
7/23/03	2110.1	9142.2	3.9	34.8	1664.1	4922.5	923.2	148.9	3970.0	12923.0	4237.3	348.6	16893.0	31872.8
7/24/03	1718.9	7603.2	3.6	30.5	1402.3	4048.5	785.8	117.9	3374.3	9697.2	3435.6	325.6	13071.5	25407.8
7/25/03	1504.5	6627.6	3.3	26.8	1208.6	3530.8	687.3	102.1	2956.1	8567.7	3014.6	300.4	11523.8	22258.7

Average summer day emissions ** :

	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
	1480.5	**6619.8**	**3.0**	**25.5**	**1149.6**	**3617.2**	**659.9**	**109.0**	**2867.5**	**9789.1**	**3219.0**	**272.4**	**12656.6**	**23453.5**

* BVOC = OLE+PAR+TOL+XYL+ALD2+NR+ETH+FORM+ISOP (based on methodology used by EPA to create default 2002 BVOC EI)

** Average summer day emissions are based on data from (June 1, 2003 to June 15, 2003), and (June 20, 2003 to July 23, 2003).

BVOC emissions (in tons/day) from 36 km domain:

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
5/19/03	1460.4	7091.1	4.0	27.5	1124.9	4108.5	740.8	118.1	2694.9	13498.5	3726.3	435.2	16193.4	28173.9
5/20/03	1602.6	7723.3	4.2	30.4	1235.6	4312.2	782.0	124.1	3050.4	14274.6	3891.4	429.2	17325.0	30089.1
5/21/03	1780.2	8640.5	4.6	34.4	1378.4	4866.5	881.9	141.6	3379.5	15882.6	4417.0	467.5	19262.1	33610.7
5/22/03	1988.2	9693.4	5.0	38.6	1553.1	5398.6	988.4	157.8	3774.7	17023.0	4878.1	516.4	20797.7	36846.2
5/23/03	2254.6	11002.3	5.4	43.6	1771.4	6010.0	1106.9	177.4	4304.5	17845.5	5408.1	562.9	22150.0	40217.1
5/24/03	2264.0	11130.6	5.5	45.3	1792.0	5926.0	1107.2	172.9	4392.4	16505.5	5299.9	574.0	20897.9	38949.0
5/25/03	1874.2	9273.0	5.0	39.2	1482.6	4974.3	938.9	140.9	3652.1	14188.8	4445.3	528.1	17840.9	32916.8
5/26/03	1810.3	8956.6	4.9	37.3	1408.8	4961.5	918.6	142.6	3449.4	15183.9	4495.6	510.7	18633.3	33424.5
5/27/03	2246.1	10952.4	5.4	44.1	1747.6	5970.1	1094.7	176.6	4283.5	17875.6	5396.1	549.3	22159.0	40112.7
5/28/03	2657.4	13073.4	6.1	53.1	2125.3	6957.5	1293.2	206.1	5153.0	19782.4	6208.0	616.1	24935.4	46154.4
5/29/03	2707.3	13500.7	6.3	55.0	2180.7	7237.0	1352.5	214.3	5197.6	20724.2	6458.4	653.9	25921.8	47978.0
5/30/03	2304.9	11540.1	5.8	47.9	1858.4	6250.6	1179.1	181.3	4438.5	18550.8	5577.5	619.1	22989.3	41918.9
5/31/03	2012.5	9884.1	5.2	40.5	1589.8	5476.9	1018.1	158.8	3846.4	16813.5	4927.3	559.5	20659.9	36999.4
6/1/03	2395.5	11694.9	6.2	47.9	1890.4	6335.3	1179.5	182.3	4627.9	18736.0	5662.8	559.2	23363.9	42468.0
6/2/03	2470.8	12006.8	6.2	48.8	1949.6	6503.8	1204.7	188.4	4778.4	18843.0	5815.9	563.0	23621.4	43222.0
6/3/03	2574.2	12438.4	6.3	49.8	2032.7	6604.6	1225.1	192.1	5022.0	18431.0	5874.7	558.7	23453.0	43554.1
6/4/03	2628.5	12718.7	6.3	50.7	2098.1	6565.5	1221.7	191.0	5264.2	17959.0	5798.6	535.8	23223.2	43439.5
6/5/03	2707.8	13131.4	6.4	52.4	2204.5	6500.5	1223.8	187.7	5607.6	16635.9	5650.1	509.2	22243.5	42650.3
6/6/03	2686.7	13055.1	6.4	52.3	2198.0	6456.2	1211.8	186.5	5618.7	16567.6	5615.6	492.5	22186.4	42420.6
6/7/03	2680.1	13002.2	6.3	52.1	2166.2	6561.0	1220.6	190.9	5516.6	17340.5	5766.6	508.9	22857.1	43220.0
6/8/03	2679.3	13046.7	6.5	53.4	2138.6	6722.7	1249.6	195.5	5417.0	18222.5	5974.0	538.6	23639.5	44314.8
6/9/03	2473.2	12157.9	6.4	50.8	1968.5	6374.8	1199.7	182.5	4912.1	17403.0	5672.0	546.9	22315.1	41816.8
6/10/03	2244.3	11027.4	6.0	46.3	1764.8	5826.2	1094.1	165.1	4426.2	15545.1	5208.0	516.4	19971.3	37719.3
6/11/03	2201.8	10881.2	5.9	45.1	1718.9	5862.2	1087.6	167.7	4271.9	16288.2	5285.7	511.8	20560.1	38258.5
6/12/03	2297.9	11389.5	6.1	47.3	1794.6	6087.0	1128.1	175.0	4467.0	16529.6	5494.3	520.1	20996.6	39455.0
6/13/03	2247.6	11178.2	6.1	47.6	1777.8	5996.3	1128.1	169.5	4381.8	16980.9	5372.0	534.2	21362.7	39532.0
6/14/03	2426.3	11982.1	6.2	49.4	1887.9	6587.7	1211.1	191.9	4613.8	20246.8	5973.8	553.1	24860.6	44589.4
6/15/03	2783.3	13735.0	6.7	56.0	2174.8	7463.6	1368.4	221.0	5300.0	22808.3	6756.4	593.1	28108.3	50617.1
6/20/03	2126.4	10636.3	6.0	45.7	1689.4	5832.9	1102.3	163.6	4067.8	16786.9	5220.6	532.0	20854.6	38389.6
6/21/03	1967.2	9820.7	5.7	41.2	1542.6	5582.1	1036.8	157.7	3656.7	16563.0	5045.2	507.8	20219.7	36717.1
6/22/03	1992.3	9947.5	5.6	40.9	1560.0	5700.8	1048.8	162.5	3686.9	17208.7	5172.3	512.0	20895.6	37667.1
6/23/03	1993.9	9920.3	5.7	41.1	1562.9	5586.6	1039.0	157.9	3704.0	16454.6	5028.9	511.5	20158.6	36762.0
6/24/03	2076.0	10194.2	5.7	41.8	1624.8	5601.2	1040.0	159.4	3940.2	16184.2	5019.7	493.0	20124.4	36927.3
6/25/03	2433.6	11773.4	6.0	46.9	1919.2	6244.0	1152.5	181.3	4769.5	17716.9	5559.9	509.3	22486.4	41474.0
6/26/03	2971.3	14421.2	6.8	56.9	2380.5	7530.6	1384.9	222.9	5900.3	21350.0	6686.0	563.0	27250.3	50325.0
6/27/03	3280.9	16009.3	7.3	63.8	2670.9	8287.9	1541.4	245.1	6554.5	23537.6	7296.0	613.4	30092.1	55644.1
6/28/03	3494.3	17150.7	7.6	68.0	2870.5	8853.2	1642.8	263.5	7023.0	24649.4	7791.2	646.0	31672.4	59000.0
6/29/03	3472.4	17096.0	7.7	69.8	2857.5	8658.6	1627.6	254.9	7067.8	22897.5	7590.7	652.9	29965.3	56942.0
6/30/03	3167.1	15677.1	7.4	65.7	2550.5	8219.2	1539.2	240.9	6244.2	22820.5	7320.0	647.7	29064.7	54287.5
7/1/03	3286.0	15344.8	7.7	61.8	2518.8	9167.9	1662.3	276.1	5820.5	29605.1	8361.2	666.0	35425.6	61930.4
7/2/03	3261.0	15324.0	7.7	61.6	2519.9	9235.4	1679.8	277.7	5732.4	29888.9	8404.4	677.7	35621.3	62256.1
7/3/03	3349.9	15731.2	7.7	62.3	2580.1	9456.6	1711.0	286.2	5880.2	30943.0	8618.0	687.4	36823.1	64128.0
7/4/03	3426.7	16006.5	7.8	63.1	2632.8	9548.1	1724.2	289.6	6050.9	30971.3	8693.7	690.5	37022.1	64670.0
7/5/03	3486.7	16263.2	7.9	64.2	2684.8	9736.4	1755.0	295.5	6171.3	31919.4	8870.9	696.5	38090.7	66213.1
7/6/03	3400.5	15840.0	7.8	63.0	2621.8	9297.5	1694.2	280.3	6090.3	29399.2	8416.1	677.0	35489.5	62604.3
7/7/03	3304.9	15331.0	7.6	61.5	2535.6	8798.4	1610.2	263.9	6017.3	27411.9	7942.6	642.3	33429.1	59324.9
7/8/03	3178.9	14896.7	7.5	60.2	2468.6	8702.0	1591.5	259.5	5789.7	27381.9	7867.7	645.7	33171.6	58546.8
7/9/03	3552.4	16421.6	7.8	64.0	2725.6	9667.4	1740.2	294.5	6345.5	30228.1	8778.0	677.7	36573.6	64701.7
7/10/03	4082.5	18804.4	8.5	72.8	3156.5	10900.7	1958.2	335.5	7359.4	34435.0	9851.1	726.8	41794.4	73753.9
7/11/03	4242.7	19623.7	8.8	77.4	3309.0	11141.9	2032.0	340.2	7721.3	35181.1	9977.0	756.7	42902.4	75956.8
7/12/03	4278.5	19856.8	8.9	78.8	3350.1	11333.2	2068.8	345.6	7774.3	35815.4	10152.9	777.1	43589.7	77136.0

BVOC emissions (in tons/day) from 36 km domain (cont'd):

Date	OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO	ISOP+TERPB	BVOC *
7/13/03	3960.4	18702.0	8.7	75.0	3155.1	10960.1	2008.3	330.7	7157.9	35988.0	9831.0	786.6	43146.0	75188.4
7/14/03	3941.3	18639.2	8.6	73.1	3122.1	11029.4	2008.5	334.7	7009.7	36533.7	9924.6	788.8	43543.5	75690.7
7/15/03	4096.0	19118.1	8.8	76.1	3236.7	11030.3	2034.9	332.9	7362.6	34432.4	9835.3	794.9	41795.0	74366.4
7/16/03	4125.6	19185.4	8.9	77.8	3264.0	10969.6	2041.7	329.3	7439.5	34295.6	9727.7	791.2	41735.2	74298.0
7/17/03	4231.3	19474.6	9.0	78.2	3328.5	11022.3	2055.8	331.5	7611.9	33791.1	9728.5	774.3	41403.0	74322.3
7/18/03	4424.2	20330.0	9.2	81.2	3498.6	11297.3	2112.6	340.2	8059.3	33693.8	9915.2	768.2	41753.1	75787.0
7/19/03	4606.0	21309.0	9.5	85.6	3686.9	11777.8	2204.5	354.9	8504.4	35474.8	10315.0	783.3	43979.2	79509.0
7/20/03	4526.4	20999.9	9.4	83.9	3623.9	11694.1	2179.9	352.6	8361.0	35203.5	10280.7	787.0	43564.5	78673.7
7/21/03	4449.7	20568.5	9.3	81.1	3564.5	11275.1	2109.9	339.2	8296.6	32742.4	9855.2	770.1	41039.0	75139.7
7/22/03	4627.0	21305.0	9.4	84.2	3684.8	11559.5	2159.8	348.8	8621.8	34092.8	10099.1	778.3	42714.6	77871.2
7/23/03	4694.7	21741.3	9.6	87.0	3774.4	11850.1	2221.1	356.3	8765.4	35159.0	10338.1	804.1	43924.4	79893.6
7/24/03	4237.3	19958.2	9.3	81.9	3470.3	11151.7	2114.8	330.2	7906.8	33513.0	9729.4	798.3	41419.9	74866.9
7/25/03	3915.7	18502.5	9.0	76.6	3201.0	10386.2	1988.4	305.0	7237.2	30833.4	9044.6	773.7	38070.7	69217.9

Average summer day emissions ** :

3204.2	**15243.0**	**7.4**	**61.3**	**2531.4**	**8448.9**	**1560.7**	**250.9**	**6016.0**	**25291.7**	**7539.5**	**636.3**	**31307.7**	**56599.5**

* BVOC = OLE+PAR+TOL+XYL+ALD2+NR+ETH+FORM+ISOP (based on methodology used by EPA to create default 2002 BVOC EI)
** Average summer day emissions are based on data from (June 1, 2003 to June 15, 2003), and (June 20, 2003 to July 23, 2003).

Average molecular weight (g/mole):

OLE	PAR	TOL	XYL	ALD2	NR	ETH	FORM	TERPB	ISOP	CO	NO
28.4	17.1	22.5	108.8	31.7	24.1	28.0	30.0	136.0	68.0	28.0	30.0

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